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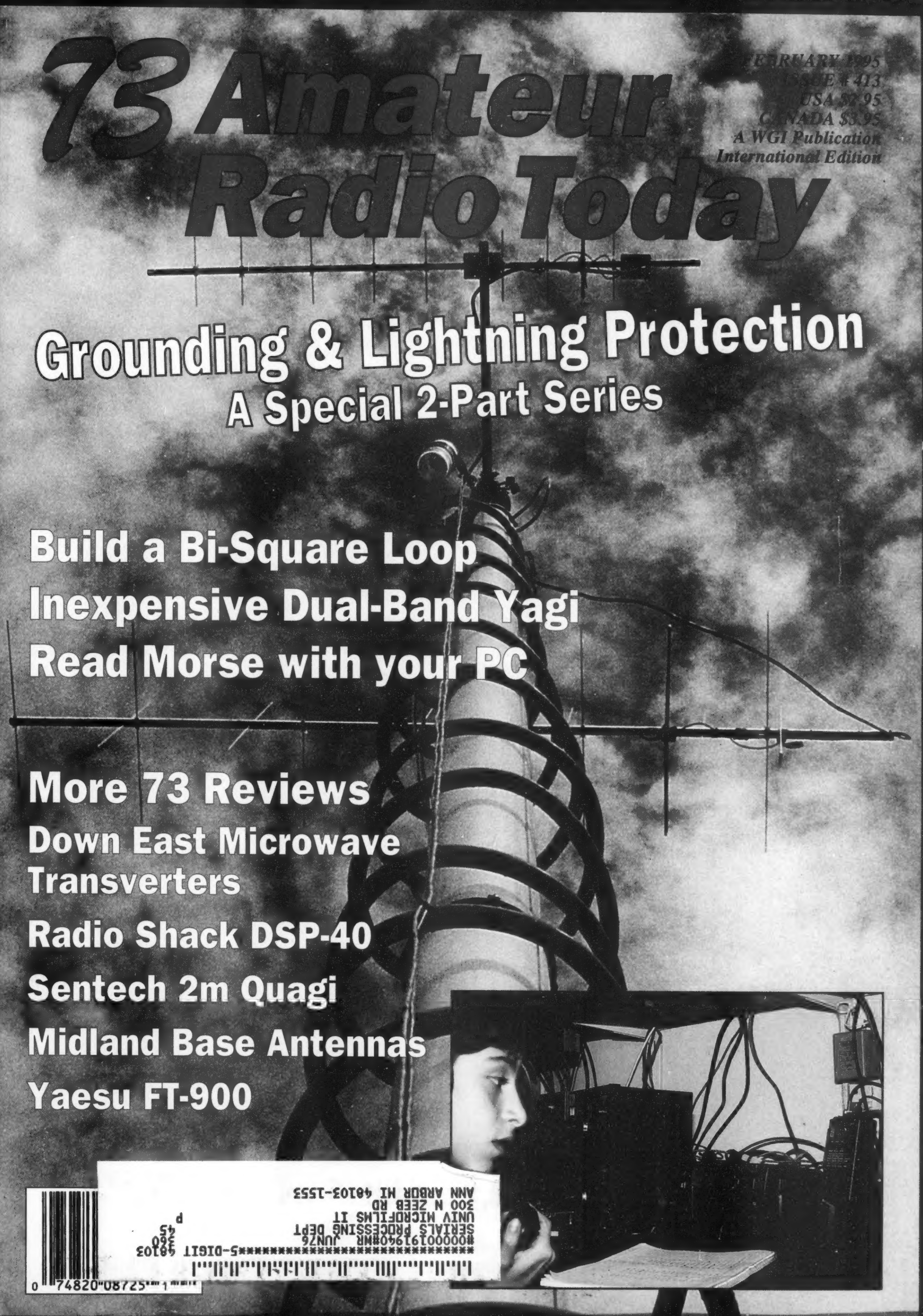

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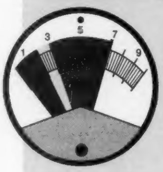

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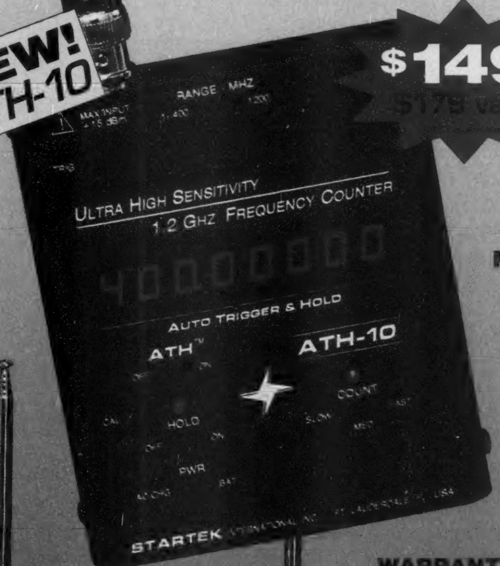

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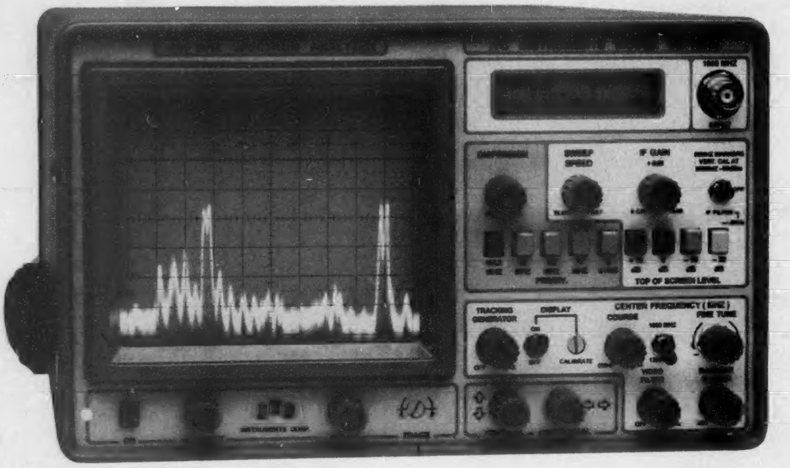

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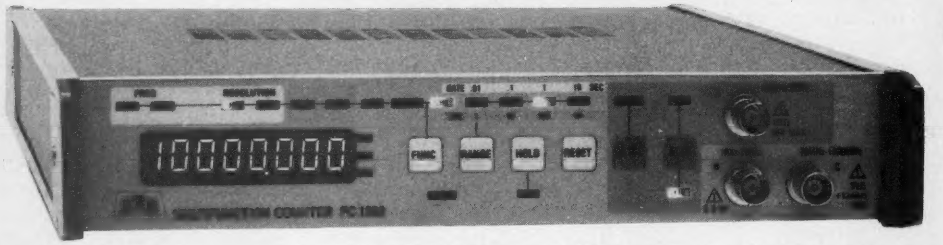

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On the cover: A sky view of the satellite antennas at the recent AMSAT Space Symposium in Orlando, Florida. (Photo by George E. Caswell Sr. K1MON.) Inset: Rob KD6EWT, age 12, operates the new Yaesu FT-900 in real contest conditions. (Photo by Steve Katz WB2WIK/6.) One-year subscription extensions go to each of these photographers in the ***73 Photo Search****.*

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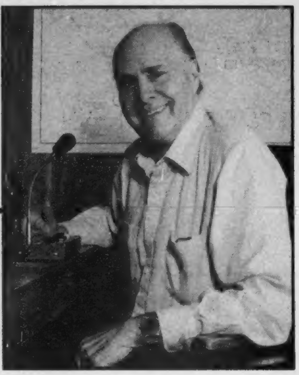

Odd Coincidence

The next time you're short of things to talk about on the air . . . like probably your next QSO . . . there's something that'll get you some attention.

First, a little background. Last month I wrote about life vs. matter. I've always been interested in anomalies, so I've got quite a library of books about odd things that have happened. Such as the books by Charles Fort and Frank Edwards. I've got shelves of UFO books, books on reincarnation, ESP, past lives, out of body experiences (OBEs), near death experiences (NDEs), psychics, and so on. All of these fields have been carefully researched, so if you categorically think the whole business is hooey, it's because you haven't done your homework. It's easy to be sure of something you know little about.

One of the scientists I met at the Maui cold fusion conference was Dr. M. Srinivasan (Chino), the Associate Director of the Bhabha Atomic Research Center in Bombay. Since I'd met another Dr. M. Srinivasan at a subtle energies conference a few months before, I wondered if Chino was any relation. The first one had asked me to critique his book on *Earth Energies*. Nope, no relation.

Chino is on the *"Cold Fusion"* magazine board of scientific advisors, so I've been keeping in touch with him. He sent me a copy of a newspaper series he'd written about extra-sensory perception of nuclear structure and atomic particles.

A hundred years ago people were much more interested in psychic phenomena than they are today. Ouija boards and seances were common. We tend to laugh at all that nonsense now, chuckling at the naïveté of the 19th century, but that's only because so few of us have read the literature.

In 1895, one hundred years ago, Annie Besant and C.W. Leadbeater clairvoyantly observed and documented in detail the structure of all 92 naturally occurring elements, right down to the sub-quark level, including isotopes. The two were eminent theosophists and authored dozens of books on subjects such as life after death, reincarnation, and the astral plane.

It was these two people who discovered Jiddu Krishnamurti when he was 12 years old and predicted he would grow up to be a world teacher. I've read many of Krishnamurti's books and attended his lectures, so I know what an incredible person he was.

Besant and Leadbeater started with hydrogen, the simplest element. They found that it was made up of 18 subatomic particles which they christened Ultimate Physical Atoms (UPAs). They reported that the other elements were made up of the same subatomic particles, but whose numbers increased in multiples of 18. This was done well before Rutherford discovered the atomic nucleus in 1911. In the 1920s the Bohr-Schrödinger hydrogen model had one proton with one electron orbiting around it. There was no way for there to be 18 particles in the hydrogen atom, much less the 4,267 particles the clairvoyants had counted in a uranium atom.

Of course, in 1963 Gell-Mann and Zweig discovered that the proton and neutron are each made up of six quarks, each of which is made up of two types of three smaller sub quarks. 18. I'm currently reading Gell-Mann's recent book, *The Jaguar And The Quark*, which is fascinating. Look for it.

A trained Yogi can see hidden, small or distant things. He can not only magnify (micro-psi) things, but can slow down their action. In 1991 a Canadian, Ronald Cowen, who had been practicing meditation for several years, when he read about this, tried it out and found that he too could visualize Micro Physical Atoms (MPAs) and their UPAs. Cowen went on to do something even Besant and Leadbeater hadn't been able to do, he provided a description of the structure of a single electron.

Besant and Leadbeater spent years clairvoyantly examining all of the elements. They found that by dividing the number of UPAs by 18 they arrived at the atomic weight for each element. They discovered that several elements had two sets of UPAs, and this was five years before Aston's discovery of isotopes in 1912. They were surprisingly accurate in their estimates of atomic weights and their placement in the periodic chart. They even discovered five elements which were unknown to science at the time of their work.

Their drawings of the UPAs (subquarks) are surprisingly similar to those in a pre-publication edition of a book James Carter recently sent me on his proposed new model of atomic structure. These UPAs seem to be made up of toroidial-shaped spinning helixes of energy. They counted spirals or whorls and found there were seven levels of them. The first layer had 10 whorls. Each of these were made up of 1,680 turns of helical coils, and so on down for at least seven levels of abstraction. Coils made out of coils, made out of coils.

This configuration was confirmed in 1992 by Cowen and reported S.M. Phillips. An earlier micro-psi researcher, Edwin Babbitt, published a book in 1878 which showed a diagram that looks much like the UPAs of Besant and Leadbeater. When you consider that the latest theories on protons and electrons is that they are actually tiny vortices of some sort of field, and not particles at all, you can see why the clairvoyants have had a problem describing what they've seen. And how amazingly accurate their descriptions have been.

Now, how did these clairvoyants manage to visualize and describe atomic structures which scientists have had to use enormous cyclotrons and Van Der Graaff accelerators to view? Can you see why I've been urging researchers to look into the power of the mind? It appears that this is a tool which can be used to investigate not only the micro-universe, but also the macro . . . as well as helping us to learn more about life itself . . . and death.

I suspect that no American scientist would never dare to publish such an article. He'd be ridiculed by other scientists for even suggesting that the work of Besant and Leadbeater was anything more than just lucky guesses. Micro-psi, indeed! Buncha crap. Loony. Crack-pot.

Well, as I've mentioned before, since getting involved with cold fusion I've been excited to meet as many respected scientists as I have who do have open minds. These are truly exciting times.

My Frustration

When I give talks at hamfests and conventions I often ask for a show of hands. How many of you are involved with working DX? Contests? Home construction? How many have been on a DXpedition? How many are active above 450 MHz? How many on RTTY? Packet? Slow-scan? Foxhunting? Satellites? And so on through the major ham activities open to us.

The discouraging part is the pitiful showing of hands. One, two . . . often none. What does it take to get you off dead center? Here we are in the middle of an extravagant banquet and you are nibbling a cracker. Even those who are devoting what's left of their lives to rag-chewing aren't talking about anything much. The rig here is . . . blah, blah. Hell's bells, read some books and make your contacts interesting.

When I write about the interesting things I've done in amateur radio I get tagged as a braggart and an ego case. All I'm trying to do is get you off your duff and into life. I'm busier than all hell, yet somehow I've managed to work seven states on 10 GHz. I've worked 100 countries on 20m in one weekend. I've DXed from Nepal, Lesotho, Swaziland, New Caledonia, and Sabah. And if you think all this takes big money, you haven't bothered to read my books. It doesn't cost much to do things, it just takes some determination.

I've had a ball on RTTY, on packet, on slow-scan, and so on. Well, I want to somehow goad you into sharing the fun I've had. I love good music, so I've been doing my best to get people to enjoy it with me. I wish you could see the letters I've been getting from people thanking me for my Scott Kirby ragtime CDs. Scott has turned into a giant in ragtime. And the piles of mail thanking me for the over a hundred sampler CDs I've produced. I also get letters thanking me for putting readers onto some of the more exciting books I've read.

Yes, I go to the movies about once a week. And I watch some TV too. But mostly I read, write, and try to keep my many businesses going despite occasional treachery by trusted assistants. I'm not on the air as much as I'd like, but that's your fault. When I do get on I quickly get bored with routine QSOs. 90% of the chaps I run into on 20m seem to be retired and doing nothing further with their lives. I want to know what they've read recently that I'd enjoy. I want to know what they've done lately that I might enjoy. It wouldn't take a lot of push to get me involved with sky diving, ultralites, and things like that. If someone opens a new area for ham adventure, I'll be out there in front.

Instead of pioneering we're all wrapped up with homosexuals suing the League to force them to run ads in *QST* soliciting members, with seeing who can be the most loathsome on

Continued on page 75

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FL-62S Dual-Band 146/446MHz w/Fold-Over, No Ground Plane Required

Gain & Wave:	VSWR:	Max Power:	Length:	Connector:
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NEW!

SB-7/SB-7NMO Dual-Band 146/446MHz w/Fold-Over, No Ground Plane Required

Gain & Wave:	VSWR:	Max Power:	Length:	Connector:
146MHz 4.5dBi ⅝ wave center-loaded 446MHz 7.2dBi ⅝ wave x 3	1.5:1 or less	70W FM	4' 7"	PL-259 or NMO style

NEW!

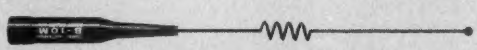
SB-5/SB-5NMO Dual-Band 146/446MHz w/Fold-Over, No Ground Plane Required

Gain & Wave:	VSWR:	Max Power:	Length:	Connector:
146MHz 3.0dBi ½ wave 446MHz 5.5dBi ⅝ wave x 2	1.5:1 or less	120W FM	38"	PL-259 or NMO style

NEW!

SB-2/SB-2NMO Dual-Band 146/446MHz

Gain & Wave:	VSWR:	Max Power:	Length:	Connector:
146MHz 2.15dBi ¼ wave 446MHz 3.8dBi ⅝ wave	1.5:1 or less	60W FM	18"	PL-259 or NMO style



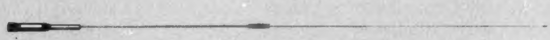
NEW!

B-10/B-10NMO Dual-Band 146/446MHz, Cellular Look-a-like

Gain & Wave:	VSWR:	Max Power:	Length:	Connector:
146MHz 0dBi ¼ wave 446MHz 2.15dBi ½ wave	1.5:1 or less	50W FM	12"	PL-259 or NMO style

B-20/B-20NMO Dual-Band 146/446MHz, Cellular Appearance, No Ground Plane Required

Gain & Wave:	VSWR:	Max Power:	Length:	Connector:
146MHz 2.15dBi ½ wave 446MHz 5.0dBi ⅝ wave x2	1.5:1 or less	50 watts	30"	PL-259 or NMO style



NEW!

SB-25/SB-25NMO Mono-Band 146MHz w/Fold-Over, No Ground Plane Required

Gain & Wave:	VSWR:	Max Power:	Length:	Connector:
146MHz 4.1dBi ⅝ wave center loaded	1.5:1 or less	100W FM	4' 9"	PL-259 or NMO style

COMET products are available from most major dealers. For customer service, or a complete catalog, please call us at 800/962-2611. We're confident COMET products and accessories will enable you to enjoy Amateur Radio to its fullest!

N.C.G. CO.

NCG COMPANIES
1275 North Grove Street
Anaheim, CA 92806
(714) 630-4541
FAX (714) 630-7024

NEW!

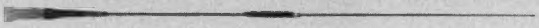
MINI SPEAKER/MIC

HM-P2K/F Mini spkr/mic featuring full TX/RX quality!

Light weight, extremely small: 1"x2" with collar pocket clip.

HM-P2K: Kenwood Version
HM-P2F: Icom/Yaesu Standard/Alinco/etc.

TRI-BAND MOBILE ANTENNAS



CX-224/224NMO Tri-Band 146/220/446MHz, w/Fold-Over, No Ground Plane Required

Gain & Wave:	VSWR:	Max Power:	Length:	Connector:
146MHz 2.15dBi ½ wave 220MHz 3.6dBi ⅝ wave 446MHz 6.0dBi ⅝ wave x 2	1.5:1 or less	100 watts	3'	PL-259 or NMO style

FJ-15S Tri-Band 52/146/446MHz w/Fold-Over

Gain & Wave:	VSWR:	Max Power:	Length:	Connector:
52MHz 2.15dBi ¼ wave 146MHz 4.5dBi ⅝ wave 446MHz 7.2dBi ⅝ wave x 3	1.5:1 or less	120 W FM	4' 10"	PL-259

HF MOBILE AND HT ANTENNAS

NEW!

HA-4S Quad-Band HF 40/*(20)/15/12/10 Meters w/Fold-Over

Wave:	VSWR:	Weight:	Length:	Max Power:	Connector:
¼ wave	2:1 or less	1 lb. 14 oz.	4' 4"	120W SSB (200W SSB 28MHz)	PL-259

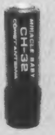
*L-14HS Optional 20 Meter Coil

SH-55 Super Flexible 146/446MHz HT Antenna

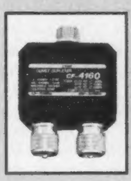
Gain & Wave:	Max Power:	Length:	Connector:
146MHz 1.5dBi ¼ wave 446MHz 3.2dBi ⅝ wave x 2	10 watts	15.5"	BNC

CH-722SA High Gain HT Antenna
Gain & Wave: 146MHz 3.0dBi ½ wave
446MHz 5.5dBi ⅝ wave x 2
Max Power: 50 watts
Length: 35", 2 sections, 18" each
Connector: BNC

CH-32 Miracle Baby 146/446MHz HT Antenna
Gain & Wave: 0dB ¼ wave
Max Power: 10 watts
Length: 1.75"
Connector: BNC



DUPLEXERS AND MOBILE MOUNTS



CF-4106K, I, J, 146/446MHz

Band Pass, Ins Loss, Max Pwr.
1.3-150MHz, 0.1dB, 800w PEP
400-540MHz, 0.2dB, 500w PEP
Isolation: 60dB

CONNECTORS:

	4160K	4160I	4160J
Output:	SO-239	SO-239	SO-239
Low In:	PL-259	PL-259	SO-239
High In:	PL-259	N-Male	SO-239

RS-21 Trunk, hatchback, rear door (van, blazer, etc.) mount. Adjustable to virtually ANY angle. Rubber-coated base protects vehicle paint.

NEW!

RS-820 Heavy-Duty, Low Profile Trunk Lip or Hatch Back Mount. Rubber-coated base protects vehicle paint.

WS-1M Multi-Adjustable Window Clip Mount. 11.5 feet of high quality coax. Gold-plated UHF Conns. for Antennas up to 40" in height.

NEW!

3D4M Standard Cable Assembly 13.5 feet of low loss coax. Gold plated UHF (PL-259/SO-239) connectors.

3D5M Standard Cable Assembly Same as 3D4M, but 17 feet of coax

CK-5M Deluxe Cable Assembly 13 feet double shielded very low loss coax + 12" RG-188 teflon coax. Gold plated UHF (PL-259/SO-239) connectors.

CK-5M5 Deluxe Cable Assembly Same as CK-5M, but 17 feet of coax

LETTERS

Number 2 on your Feedback card

From the Ham Shack

Jose L. Rivera KP4FMD, Orlando FL We couldn't believe our eyes when we saw our photograph on the cover of your magazine (November 1994). This was really a wonderful surprise. My wife and I would like to thank the *73* Photo Search committee for taking the time to examine and select the picture.

Thanks for the extended subscription, and the best of luck.

Cleve Svetlik K8NZV, Pepper Pike OH Wayne, this letter has been years in coming. Following your advice, I became involved in politics on a local level about 20 years ago, which has eaten up a lot of my free time. I do feel that I have been able to make a difference in our community, and above all, I have found the experience to be gratifying.

It was a lot of years ago when I first met you personally at your apartment in New York City, where I first subscribed to *73*. I felt then, and continue to feel, that you are one of the few people who recognize the big picture when it comes to government and its relationship to amateur radio privileges. If the Feds really wanted to, they could wipe out the amateur service and sell the frequencies to the highest bidder. Oh, they would not do it in one fell swoop, they would just continue to nibble away at the frequency allotments until nothing is left.

Selling frequencies is a rather new concept. The Federal Government cannot get enough money from the poor taxpayer, so they have gone to selling frequencies to bolster their income. In a similar vein, OSHA has raised their fines again and again under the guise of safety to help cover the cost of their agency. One can wonder what is happening to all the money taxpayers send to Washington. I thought it was for running the government.

One would hope that the ARRL would be a positive and strong force representing amateurs, especially in our relationship to the Federal Government. As you have so ably pointed out over the years, such is not the case. An effective ARRL would include the principles of fighting for every possible frequency, every possible mode of operation, and the absolute minimum of requirements and restrictions to obtain a license. Instead, we got incentive licensing and more restrictions. As you so ably put it, past ARRL actions have almost killed the hobby.

Some of the hams I talk to still hold the myopic view of requiring stiff code requirements to obtain a license. They don't want to hear the arguments that code is only one method of communicating. They also don't understand (or even think about or use) any of the computer-based systems or satellites, and never intend to. So . . . let them be. Let them have their own frequency assignments for CW. But do not let their opinion regulate other hams who wish to communicate using different modes, and above all do not let such people dictate stiff code requirements for others who wish to obtain a license but for whom the code requirements are a stumbling block. It is unfair, unjust and discriminatory. There should be room for everybody in our hobby.

Wayne, in my work as a consulting engineer I come into contact with many electrical and computer engineering folks. I get to know many of them personally since our projects tend to require many visits before the job is completed. I usually ask if they have had any interest in amateur radio, and many times I get a positive response. Over 90 percent of those who showed interest but did not obtain a license indicated that the code requirement was the reason why they turned their back on amateur radio. Since the advent of the no-code license, of the few people I have talked to, the inaccessibility of the lower frequency bands dulled their interest. We need these people.

Wayne, please keep the pressure on to get rid of the code requirement, or at least reduce it to 5 wpm for General Class. This can do nothing but help our hobby.

Cleve—Ah, the synchronicity of Great Minds. My November 1994 Radio Fun *editorial proposed that the Tech-Plus ticket be grandfathered to General.*

With the diminished relevancy of CW, there would seem to be no further need for the 13-per skill obstacle. This would reduce the cost of licensing and speed it up at a time when the FCC has fallen seriously behind in issuing licenses. It would also simplify (lower the cost) of monitoring and enforcement.

The entry of 175,000 new General Class licenses to the low bands would generate a needed growth of the amateur radio industry. The ensuing increase in activity on the low bands would, in turn, encourage the development and pioneering of more frequency-saving technologies and practices.

The increased interest in activity would tend to attract more newcomers. With there being a direct connection between technology and gross product, this would tend to attract more youngsters to high-tech careers, and thus increase America's ability to compete with other high-tech countries. . . . Wayne

Steve Katz WB2WIK/6, Chatsworth CA Wayne, I read your editorial in the December 1994 issue of *73* (I always do) and must agree that while you're hitting the nail squarely on the head, most seem to be missing the message regarding America still being the Land of Opportunity. You suggest that folks do something they like to do anyway, get really good at it, and then reap the profits. Know who the real experts are at this? The professional sports players. Most of 'em would be playing their sport out on the street, anyway, if they couldn't find professional employment. the really good ones make millions of dollars a year to do something they like to do, anyway. Perfect example of hobby becoming profession.

I love basketball but lacked the necessary physical attributes to achieve a professional level of play when I was young enough to pursue it; now I'd do better, but I'm too old. So, that one's out. Photography is another of my hobbies, and I have lots of great equipment already . . . nah, too many shutterbugs out there. Competition's too fierce, and a lot of those guys are really good. I like to ski, but not well enough to compete or teach. So much for that one. Swimming? Yep, I'm real good at that and did have professional instruction from an ex-Olympian as a kid. I've taught swimming before and it's fun. Nah, the kids don't listen and the grownups already have such bad habits. It doesn't pay well enough for the aggravation.

What about—gasp—ham radio? Can't make very much money instructing beginners. It's illegal to charge more than the FCC-prescribed fees for testing. Hmmm. Gotta be a way. How about doing ham-related stuff that nobody else wants to do? Wow!

I started a business assembling and installing antennas and towers for hams. Ya know, doing it right, so things really work and stay up for decades, not months. After 28+ years of hamming and installing my own towers and antennas at a number of sites, I ought to be qualified for this one. OK, to be legit you need a contractor's license. What's involved there? Five years minimum field experience and taking a test. I walked into the test session without a clue as to what would be on the exam—passed first try. Proved the "experience" portion by providing photocopies of invoices and payments received for similar services. I'll be darned, a contractor's license is no obstacle at all.

I advertised mostly by word-of-mouth and became booked solid for months. Working in my spare time only and charging $50 per hour (the going rate), I made enough money to support the hobby for the next century. I expanded by selling leftover goods from antenna installations at the local swap meets. This reduced inventory costs to nothing, and sold almost all materials at a profit. Gosh, this isn't hard. I started a second business as a legitimate distributor by obtaining a business license, registering with a Fictitious Business name. A tax resale certificate is free from the state Board of Equalization, and the forms take all of five minutes monthly to complete and mail in. So, when is being in business going to start being complicated?

As you know, being in business isn't complicated at all. The waters get muddy when you start hiring people, paying benefits and so forth. But if one can run a business single-handedly (or make it a family venture by involving the wife and kids), there's nothing to it. Many businesses don't require a storefront.

With the economy in the sad state it is, the aerospace and defense industries laying off almost everybody, our unfavorable balance of trade and monetary exchange rate with Japan, and the real estate market almost collapsing, no time is better than today to start a small business. I run businesses in my spare time only and keep a regular job, too, mostly for the benefits a large employer can provide (group health insurance, for one!). But if my efforts take off as I hope, I'll be able to provide my own benefits without relying on any outside employment, and make more money than any "regular" job could possibly pay.

Ham radio affords us unique opportunities to advertise for free, if we're discreet about it. Example: Joe Ham is on the air discussing his dilemma of how to install a tower on his lot without his neighbors seeing cement mixers and backhoes going back and forth, raising a lot or curiosity and ire. I have a possible solution. I call Joe and say, "Gee, I might have the way to solve your problem. If you'll give me your telephone number, I'll call you to discuss it." I get the number, make the call, and propose my services or fees were made on the air. But the *opportunity* for finding clientele surely exists, and it's free. The "sale" still needs to be made in person or on the landline, but the customers are out there on the air every day.

Of course, we can always write magazine articles. (Don't know if you've noticed, but I've had a few dozen published in *73* and *RF* over the past couple of years.) Writing for the hammy mags isn't complicated. All you need is an idea and a sharp pencil. I found some great deals on surplus commercial, lab-quality test gear (Hewlett Packard, Tektronix, General Radio, etc.) and started assembling my "home lab" years ago. Great way to test out new gear on the market and write product reviews. Once you're published in a few of the ham journals, it's easy to get published in professional journals as well. Some of them even pay pretty well for manuscripts (although some don't). My first manuscript, written when I was 14 years old, was published in *73*. That was back in 1966. Since then, my stuff has been accepted by *TV Guide*. Not bad, eh?

Anybody with a lick of initiative can make a business providing services for ham radio operators, and it needn't stop there. If you're good, word of mouth will take over and you'll be getting calls from non-hams. After being in my little business about six months, I started getting calls from CBers, scanner listeners and other SWLs, and even non-hobbyists who wanted TV antennas installed. Then, calls started coming in from public service agencies, police and fire departments, repeater/paging system owners, and then from Kenwood Communications in Long Beach, who wanted new antennas installed for their service department. I've literally had to turn away business, there's just too much of it.

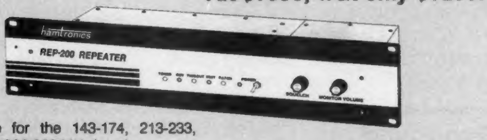
Maybe if you use some of us who have succeeded in making a business from ham radio as examples (I'm sure you've heard from others!), the message would finally get through.

You get more features for your dollar with the

REP-200 REPEATER

A fully microprocessor-controlled repeater with autopatch and many versatile dtmf control features at less than you might pay for a bare-bones repeater or controller alone!

Kit $1095; w&t only $1295!



- Available for the 143-174, 213-233, 420-475, 902-928 MHz bands.
- **FCC type accepted** for commercial service in150 & 450 bands.
- **Six courtesy beep types**, including two pleasant multi-tone bursts.
- **Open or closed access autopatch, toll-call restrict**, auto-disconnect.
- **Reverse Autopatch**, two types.
- **DTMF CONTROL:** over 45 functions can be controlled by 4-digit dtmf command, via radio or telephone.
- **Owner can inhibit** autopatch or repeater, enable either open or closed access for repeater or autopatch, and enable toll calls, reverse patch, kerchunk filter, site alarm, aux rcvr.
- **Change** cw speed and tone, beep delay, tail timer, and courtesy beep type **at any time** by owner password protected dtmf commands.
- **Auxiliary receiver input** for control or **cross linking repeaters**.
- Color coded LED **status indicators**.

NEW **REP-200T Voice Message Repeater.** As above, except includes Digital Voice Recorder. Allows message up to 20 sec. to be **remotely recorded off the air** and played back at user request by DTMF command, or as a periodical voice id, or both. ...... **kit $1145, w&t only $1395**

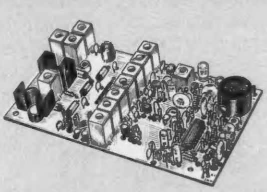
NEW **REP-200C Economy Repeater.** Like REP-200, except uses COR-6 Controller (no DTMF control or autopatch). Features **real-voice ID**. .... **Kit only $795, w&t $1095**

REP-200N Repeater. Want to use your ACC controller, etc.? No problem! We'll make you a repeater with rf modules only. .... **Kit only $695, w&t $995**

XMTRS & RCVRS FOR REPEATERS, AUDIO & DIGITAL LINKS, TELEMETRY, ETC.

Also available in rf-tight enclosures, and with data modems.

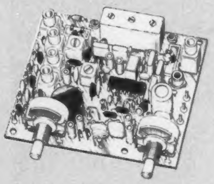
FM EXCITERS: 2W continuous duty. TCXO & xtal oven options. ***FCC type accepted for com'l high band & uhf.***



- **TA51**: 50-54, 143-174, 213-233 MHz ......kit $109, w&t $189.
- **TA451**: 420-475 MHz ......kit $109, w&t $189.
- **TA901**: 902-928 MHz, (0.5W out); w&t $219.

VHF & UHF AMPLIFIERS. For fm, ssb, atv. Output levels from 10W to 100W. Several models starting at $99.

FM RECEIVERS:



- **R144/R220 FM RECEIVERS** for 143-174 or 213-233 MHz. **Sensitive** front end, 0.18uV, both crystal & ceramic if filters plus **helical resonator** front end for exceptional selectivity: >100dB at ±12kHz (best available anywhere!) Flutter-proof hysteresis squelch; ....kit $149, w&t $219.
- **R451 FM RCVR,** for 420-475 MHz. Similar to above. ...kit $149, w&t $219.
- **R901 FM RCVR,** for 902-928MHz. Triple-conversion, ...$169, w&t $249.
- **R76 ECONOMY FM RCVR** for 28-30, 50-54, 73-76, 143-174, 213-233 MHz, w/o helical res, if selectivity >100dB at ±12kHz ....Kits $129, w&t $219

NEW **R76 MONITOR FM RCVR** Kit for 10M, 6M, 73 MHz, 2M, hi-band, or 220 MHz. IF selectivity 60dB at ±12kHz. Great for monitoring repeaters, amateur calling frequencies, or packet radio frequencies, and for listening to commercial two-way radio, police/fire frequencies, or weather forecasts. **Good starter kit, too;** easy to assemble and align. ....**Kit only $59!**

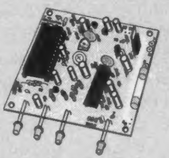
- **R137 WEATHER SATELLITE RCVR** for 137 MHz. Special if filters tailored for wideband fm. Lowest cost receiver available ....**kit only $89, w&t $149.**
- We also have preamps and receiving converters for 137 MHz, and we carry the *Weather Satellite Handbook* by Ralph Taggart.

ACCESSORIES

COR-3 REPEATER CONTROLLER. Features adjustable tail and time-out timers, solid-state relay, courtesy beep, and local speaker amplifier. ....kit $49

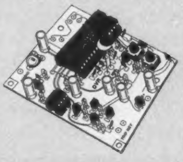
CWID. Diode programmable any time in the field, adjustable tone, speed, and timer. ....kit $59

COR-4. Complete **COR and CWID** all on one board. CMOS logic for low power consumption. EPROM programmed; specify call. ....kit $99, w&t $159



NEW **COR-6. COR & Real Voice ID** on one board. Digital ic records up to 20 seconds of your voice. Can record multiple id messages. Tail and time-out timers, courtesy beep, solid-state relay to key transmitter. kit $99, w&t $149

Versatile DVR-1 DIGITAL VOICE RECORDER Module. As a **voice ID'er for repeaters**, records your voice, using the built-in microphone or external mic. Just the thing for **fox hunt** xmtr id! May also be used as a **contest caller** to play back one or more messages through your transmitter at the press of a switch. Used as a **radio notepad,** it can record the audio output of a receiver — up to 20 sec. of anything you might want to recall later. Play back as often as you like through a small external speaker. Extensive manual tells how to use multiple messages and adapt to many applications. ....kit $59, w&t $99



TD-4 SELECTIVE CALLING Module. Versatile dtmf controller with 1 latching output. Mutes speaker until someone calls by sending your 4-digit tt code. Or use it with a long tt zero digit to alert anyone in club. Also may be used to control autopatch or other single device. ....kit $49, w&t $79

TD-2 DTMF DECODER/CONTROLLER. 16 digits, programmable, toll-call restrictor. Can turn 5 functions on/off. ....kit $89, wired & tested $149

AP-3 AUTOPATCH. Use with TD-2 for repeater autopatch. Reverse patch and phone line remote control are std. ....kit $89, wired & tested $149

AP-2 SIMPLEX AUTOPATCH Timing Board. Use with above for simplex operation using a transceiver ....kit $39

TD-3 SUBAUDIBLE TONE DECODER/ENCODER. Adjustable for any tone. **Especially for repeaters,** with remote control activate/deactivate provisions ....kit $29, wired & tested $59

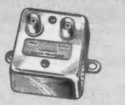
DATA MODEMS

MO-202 FSK DATA MODULATOR & DE-202 FSK DEMODULATOR. Run up to 1200 baud digital signals through any fm transmitter & receiver. Radio-link computers, telemetry, etc. ....kit ea $49, w&t ea $79

9600 BAUD DIGITAL RF LINKS. Low-cost packet networking system, consisting of MO-96 Modem and special versions of our 144, 220, or 450MHz FM Transmitters and Receivers. Interface directly with most TNC's. Fast, diode-switched PA's output 15 or 50W. CALL.

Low Cost GaAsFET PREAMPS

LNG-(*)



ONLY $59 **wired&tested**

FEATURES:

- **Very low noise:** 0.7dB vhf, 0.8dB uhf
- **High gain:** 13-20dB, depends on freq
- **Wide dynamic range** - resist overload
- **Stable:** low-feedback dual-gate FET

**Specify tuning range: 26-30, 46-56, 137-152, 152-172, 210-230, 400-470, 800-960 MHz.*

LNW-(*) MINIATURE PREAMP

ONLY *$29* kit, *$44* wired&tested

- GaAs FET Preamp similar to LNG, except designed for **low cost & small size.** Only 5/8"W x 1-5/8"L x 3/4"H. Easily mounts in many radios.

**Specify tuning range: 25-35, 35-55, 55-90, 90-120, 120-150, 150-200, 200-270, 400-500 MHz.*

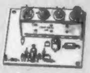
LNS-(*) IN-LINE PREAMP

***ONLY $89* kit, *$119* wired&tested**

- GaAs FET Preamp with features similar to LNG series, except **automatically switches out of line during transmit.** Use with base or mobile transceivers up to 25W. Tower mounting brackets incl.

**Tuning range: 120-175, 200-240, or 400-500.*

HELICAL RESONATOR PREAMPS



GaAs FET preamps with helical resonators **reduce inter-mod & cross-band interference** in critical applications. **MODEL HRG-(*),** ***$80 vhf, $110 uhf.***

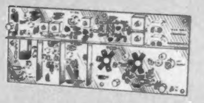
**Specify tuning range: 142-150, 150-162, 162-174, 213-233, 420-470.*

RECEIVING CONVERTERS

Low noise converters to receive vhf and uhf bands on a 10M receiver.

- Input ranges avail: 50-52, 136-138, 144-146, 145-147, 146-148, 220-222, 222-224 MHz, 432-434, 435-437, 435.5-437.5, and 439.25 (to chan 3).
- **Kit less case *$49,* kit w/case & BNC jacks *$74,* w&t in case *$99.***

TRANSMITTING CONVERTERS



XV2 for vhf and XV4 for uhf. Models to convert 10M ssb, cw, fm, etc. to 2M, 220, 222, 432, 435, and atv. 1W output. ***Kit only $89.*** PA's up to 45W available.

- Buy at low, factory-direct net prices and save!
- For complete info, call or write for free catalog. *(Send $2 for overseas air mail.)*
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Capitol Ham

David Funderburk K4TPJ is among the newest members of the United States House of Representatives. Funderburk is not only an amateur—he also holds a PhD and has taught history at several North Carolina colleges. The 50-year-old Republican served as U.S. Ambassador to Romania during the Reagan years.

Funderburk describes himself as an "avid amateur radio operator," and holds a General Class ticket. He represents North Carolina's 2nd Congressional District. *TNX Florida Skip, Vol. 36, No. 12, December, 1994.*

Tech Minus

Due to an apparent miscue at the FCC, a lot of Technician Plus amateur operators have been issued licenses which do not reflect their code privileges. If you earned your Technician Class ham ticket before March 16, 1987, you are automatically a Tech Plus—meaning you also passed a code test.

But the Commission's computer has coughed out an undetermined number of licenses without the Plus designation. If you could fit into this category of operator, perhaps you should take a closer look at your license.

If you were shorted the Plus designation, write to the FCC explaining the situation. Include information on your current license status and effective date. Send a photocopy of your license with the letter. Address it to: *Federal Communications Commission, 1270 Fairfield Road, Gettysburg, Pennsylvania 17325-7245; FAX (717) 337-1541.* The Commission advises it will take from four to six weeks to process the correction. *TNX KC6IJE; Palo Alto Amateur Radio Association's "PAARAgraphs" newsletter, December 1994.*

Band Changes Proposed

The FCC has adopted a Notice of Proposed Rule Making to convert a block of spectrum from federal government to commercial use, including two UHF bands currently available to amateurs on a secondary basis with the government. The proposal calls for reallocation of 2390-2400 MHz, 2402-2417 MHz, and 4660-4685 MHz to fixed and mobile commercial use. (A 4660-4685 MHz change would not affect amateurs.)

Under the Omnibus Budget Reconciliation Act of 1993, the FCC is required to adopt rules for such a move by February 10. A number of responses to the proposed changes have been received by the Commission, including many from the amateur community. *TNX Dayton Amateur Radio Association's newsletter "RF Carrier," December 1994.*

Dial Defense Surplus

Interested in restocking your ham shack with Department of Defense surplus property? A new toll free number has been instituted to make it easier. Simply call (800) GOVT BUY (800-468-8289).

The DOD Surplus Property Sales Program is managed by the Defense Reutilization and Marketing Service, a field activity of the Defense Logistics Agency, and is authorized to sell government surplus stuff. Not just ships and tanks, mind you, but office equipment, sporting goods, furniture, tools, nuts and bolts, and clothing, to name just a few.

The information is free, but be advised that a lot of this surplus is sold by auction and "as is." Still, with the government shutting down bases at a record clip, surplus is piling up as never before, and may be worth looking into.

Distinguished Service

The Quarter Century Wireless Association has bestowed the coveted Distinguished Service Award on Kenneth M. Miller K6IR (see Photo A). The award was given at the 1994 QCWA National Convention at El Paso, Texas. This award recognizes Miller's engineering accomplishments and his leadership of the Radio Club of America Scholarship Program.

Mr. Miller's professional career has spanned over four decades and three continents. He has served as an executive with Lear Jet, Motorola, American Standard, The Singer Company and others. Nice work Ken!

The Electronic Way

The FCC has released a seven-page order amending its rules to reflect what it calls "nonsubstantive procedural changes." Among these changes, the Commission will now permit electronically-filed license application data from VECs, although paper applications will continue to be accepted.

Also new is the following: To authorize operation as soon as the new license data appears in the new amateur service licensee data base, rather than the current system of waiting for the license document to be delivered. Details of how this will be implemented are upcoming. The "Technician Plus" designation will now be treated as an official license class. The Commission also plans to mail a shorter license renewal form to amateurs in advance of their expiration date. *TNX Badger State Smoke Signals, December 1994; ARRL.*

Update

In January's "QRX" column Dr. Karl Meinzer of the AMSAT Phase 3-D International Satellite Design Team was mentioned with the wrong callsign. Karl's call is DJ4ZC. Sorry for the mix-up.

QCWA
QUARTER CENTURY WIRELESS

Photo A. Kenneth M. Miller K6IR with the QCWA Distinguished Service Award.

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73 Review

Number 4 on your Feedback card

by Steve Katz WB2WIK/6

The Yaesu FT-900AT HF Transceiver

Yaesu U.S.A.
17210 Edwards Rd.
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Telephone: (310) 404-2700
Price Class: FT-900—$1,499;
FT-900AT—$1,699

Base station performance from a compact mobile rig!

When given the opportunity to try out the new Yaesu FT-900AT for a product review, I thought, "Neat! This is a rig I thought about buying anyway—and now I can try one out before I do!" In early November 1994, FT-900AT serial number 41040690 arrived on my doorstep. By the end of that same day, I had already made 41 contacts with the little rig and had a pretty good feel for it, despite not having opened the Operating Manual at all! That's what I call "user friendly."

Overview

The FT-900AT is about as full-featured an HF rig as there can be in such a tiny box: Measuring only 238 x 93 x 253 mm (9.37 x 3.66 x 9.96") (W x H x D) and weighing only 5.3 kg (11.66 lbs.), it packs "base-station" performance into a mobile-sized radio. The FT-900 and FT-900AT are identical, except that the "AT" version includes a built-in automatic antenna tuning unit, the Yaesu ATU-2 (which can be added to the '900 in the field); however, the '900AT, which has the tuner "factory installed," costs a bit less than buying the two units separately. All discussions herein, except those specifically pertaining to antenna tuner performance, apply to either model.

The rig features a general coverage receiver (100 kHz through 30 MHz) and all-mode operation (CW, SSB, AM, FM, plus SSTV with outboard converter and digital modes with outboard TNC), delivering 100 watts PEP output power (within the ham bands only) from its sturdy, well-cooled transmitter. Output power is adjustable by a front-panel control down to approximately 1.5 watts for honest QRP work. Frequency tuning is accomplished by a large, easy-to-handle, rubber-coated VFO knob, or by pushing "up" or "down" buttons on the supplied push-to-talk microphone. The main display panel contains all the information needed to understand every critical control setting, with a large, easily-read LCD display of operating frequency. The features will be covered later in more detail, but the most significant feature, which differentiates the FT-900 from its predecessor FT-890, is the rig's removable front subpanel. The '900's front subpanel, containing the most-used controls and microphone jack, disconnects from the radio's body with a push of one button ("click") and can be remotely located anywhere within about 19 feet of the radio itself, greatly simplifying mobile installation.

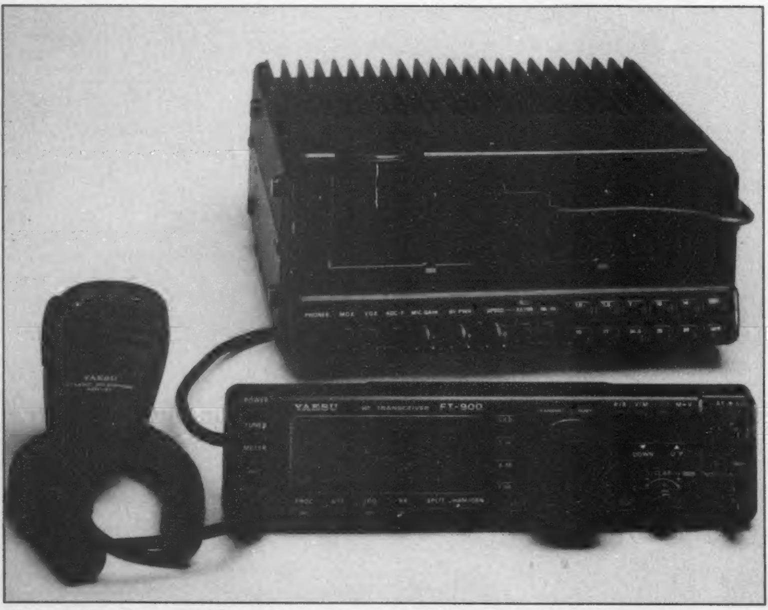

Photo A. The Yaesu FT-900 with front subpanel detached. The subpanel "clicks" off with a finger latch.

Opening the Carton

Impressive is the only word that describes Yaesu's excellent packaging job. Not only are all parts well-protected (the subpanel is packaged separately from the radio's body, giving the new owner an opportunity to try the panel's "mount/dismount" feature almost immediately), but Yaesu thoughtfully includes a world map showing updated amateur radio DXCC countries and prefixes, a large Yaesu decal (bumper sticker?), all the plugs required to put the radio into immediate service, spare fuses, a long DC power cable (dual-fused) and an excellent, easy-to-use, 50-page Operating Manual, complete with schematic diagrams. On the plus side for Yaesu, the manual is great. The "Operation" section contains a "Getting Started Tutorial" (2-1/2 pages) which offers sufficient information to get on the air and start using the rig to its fullest, without having to read through dozens of pages of babble. On the minus side, the FT-900 manual, like most of those from the Japanese manufacturers, offers no hint of any circuit descriptions, theory of operation or a technical troubleshooting guide. Unfortunately, this is the norm for modern rigs from JA-land, so I'm not singling out Yaesu when I complain; the only manufacturer who provides essentially a complete "service manual" right within their normally-supplied operating manual is Ten-Tec (an American company).

Controls

When I first acquire a new piece of gear, I like to see if I can make it work without opening the instruction manual. I won't even buy computer software that requires a substantial time investment in training, as I'm old-fashioned enough to consider it unreasonable for me to spend money on products that will take more time to learn than they could save me in the short term. The FT-900AT passed my test: I completed two log pages full of QSOs on both SSB and CW before I turned to page 1 of the book. Bravo! All ham equipment should be this easy to use.

The front subpanel controls are clustered for easy use. The TUNER switch both activates the internal ATU for use (momentary press) and operates the ATU (longer press, same button). Hooray! No reason to use two switches when one will do. The POWER switch is a "soft-start" type with electronic time delay: A quick press neither turns the rig ON nor OFF. The switch must be depressed for about a half-second to toggle the POWER function. The MAIN TUNING knob has a great feel, and adjustable "drag" using a hidden setscrew. The DISPLAY screen has a warm orange glow with dark gray alphanumeric segments, and is easy to read in almost any

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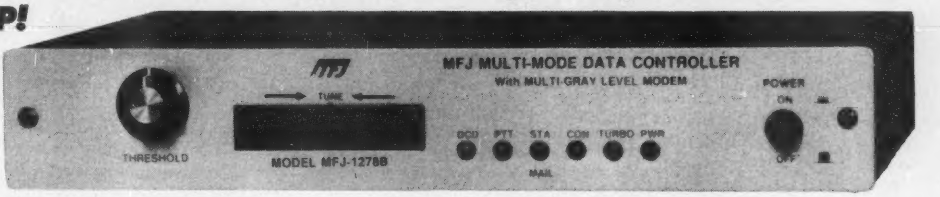

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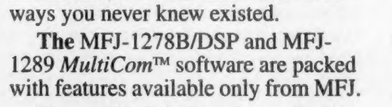

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lighting. It displays MODE; filter selection (NAR); GENeral coverage selection (as opposed to “ham” coverage); VFO status (A, B, or SPLIT); FAST tuning mode; dial LOCK; TUNER status (WAIT appears while tuner is searching); HI SWR indicator (if mismatch is too severe for the ATU to find a match point); operating frequency displayed to 10 Hz resolution with separate decimal point indicators; +/- offsets for RPT (repeater) mode; memory SCAN and CHECK status; CHannel number (01-99); MEMory status (V/M, V>M, M>V, and M TUNE); a CAT (computer aided transceiving) indicator; as well as a multisegmented bar graph S-meter and ALC/SWR (switchable) meter. (The S-meter always operates, displaying received signal strength or transmitter power output power; the other bar-graph display switches between ALC, SWR and “off,” using the METER switch.) Whew! You think that's a lot? Just wait.

Photo B. The FT-900 subpanel installed in the author's car using Velcro strips. For permanent installations you could use a gooseneck accessory fixture instead.

The removable subpanel also contains volume (AF) and squelch (SQL) concentric controls; IF NOTCH and SHIFT concentric controls, with a center-detent on the SHIFT control and a separate switch for the NOTCH function; DOWN and UP push-buttons for stepped frequency tuning; VFO and memory function push-button keys (as described above under “memory status”); a FAST tuning push-button (a multipurpose key for fast frequency changes using the dial or the UP/DOWN keys—and also serves for making 11 different “FAST” set-up adjustments); mode keys (SSB, CW, AM, FM); and four LED-lighted keys for the speech PROCessor; receiver ATTenuator; receiver preamp bypassing (IPO); and noise blanker (NB). The CLARifier control, with its separate on/off switch and indicator, serves the same purpose as an RIT. An LED lighted indicator also serves as a “TRANSMIT-BUSY” light (green when BUSY, red when TRANSMITting). Now you can say, “Whew!”

Despite the quantity of controls on the subpanel (28), the FT-900 is not a confusing rig to operate, especially if you're familiar with other modern HF gear. A proponent of “simple” rigs, I don't like a lot of unnecessary knobs and switches, and I tend to really dislike “function” keys. The FT-900's panel is not cluttered, and there are no function keys. I found it surprisingly simple to use, and the controls are intelligently labeled for intuitive use right out of the box.

Besides the subpanel controls, there are these additional “main unit” front-panel controls, which cannot be adjusted by the subpanel (and thus are “lost” to the user when remoting the rig): PHONES jack; MOX, VOX and AGC-Fast switches; MIC GAIN; RF PWR (xmtr output); KEYER switch and SPEED control; BK-IN (QSK) on/off; and the 12-button keypad used for either direct frequency entry (very handy—just like a “big” rig!) or rapid band changes. I love the direct-entry keypad. My “big” Kenwood TS-850S/AT has it, as have some of my other radios, but this is something not previously found on a smaller, mobile-type transceiver. This is a major product improvement over the otherwise similar FT-890: Once you use direct-entry QSY, you'll find it hard to live without.

If, say, you are on 7238 kHz and want to instantly QSY to 28335 kHz and the latter frequency is not in a previously-stored memory, all you need to do is press ENTer, followed by 2-8-3-3-5, and then ENTer again, and—bingo!—you're there. Much faster than changing bands and dialing around with the VFO. I once paid hundreds of dollars to get this feature as an option for a Collins KWM-380 (a $4,000 rig). Now, it's “free,” included in every FT-900.

The front-panel headPHONES jack accepts either stereo or monaural 'phones, and provides audio to both sides either way. The FT-900's rear-panel contains the DC power connector, ANTenna connector, and four less-frequently used controls: VOX GAIN, ANTI-TRIP, DELAY and speech COMPression level adjustments. I don't mind “losing” these controls in a remote/mobile setup, but would prefer to have at least the DELAY control right in front of me when using the rig at home, since this control adjusts not only the VOX drop-out timing for SSB, but also the drop-out delay for non-QSK (semi break-in) CW work, and might require frequent adjustment as one changes his CW sending speed. One more point: The MIC GAIN control is lost when remoting the rig, and I think this is unfortunate. When operating mobile, the MIC GAIN is one control I find myself adjusting quite a lot, depending on background noise (low with windows closed, high with windows open) and operator's voice characteristics. (I “close talk” the mike and speak loudly, so I require a very low gain setting; others like to hold the mike back a few inches—not a good idea when operating mobile!—or speak softly and will require a much higher gain setting.)

The FT-900 does not have a receiver RF GAIN control! I didn't even notice this until Yaesu Service Manager Chip Margelli K7JA pointed it out. I didn't miss it, either: If a receiver has sufficient dynamic range and good AGC, one would very rarely have any reason to turn its RF GAIN down from “maximum.” I can't remember the last time I purposely turned down the RF GAIN control on any of my rigs. Good riddance to this control. (Actually, there is just one example of when this control would be useful: When using high-speed CW on full QSK, it is nice to turn the receiver's AGC “off” altogether, turn the VOLUME way up, and use the RF GAIN like a “volume” control. Maybe one in a hundred operators would actually do this. I operate CW 95% of the time, and I haven't done it in years.)

Input/Output Ports

For a small rig, this one sure has a lot of I/O options! I applaud Yaesu's use of standard “RCA phono” receptacles for the following: +13.5 VDC (to power small accessories); PTT (for a footswitch or other remote PTT accessory); TX GND (circuit closes to ground on xmit, to key a linear amplifier); PATCH IN (phone line input for patching); and EXT ALC (ALC connection to a linear amplifier). So many modern rigs place these functions on the pins of weird connectors we won't have handy. “Phono” jacks are easy to use, easy to find, and allow easy use of shielded cables to prevent RFI problems.

Besides those jacks listed above, the FT-900 also contains the following I/O ports: EXT SPKR (“mini” phone jack); DATA IN/OUT (three-contact “mini” phone jack, for TNC connection); TUNER (5-pin mini-DIN jack for the FC-800 external antenna tuner option); CAT (6-pin mini-DIN jack for external computer control of the FT-900); BAND DATA (8-pin mini-DIN jack providing control signals for the FL-7000 linear amplifier; could be used to provide BAND data for other amplifiers as well); KEY (3-contact “mini” phone jack, used for paddle connection when using the internal electronic keyer, or straight key/outboard electronic keyer connection); and DVS-2 (7-pin mini-DIN jack for connection of the optional DVS-2 digital voice recorder). Also on the rear of the radio is the air inlet grill for the automatic forced-air cooling system, and a healthy GND (ground) terminal for attachment to earth ground. Sound like enough for a “mobile” rig? If you're getting the impression the FT-900 is nearly a base station radio, you're catching on. I applaud Yaesu's use of different types of connectors for the various options; there is no way one could inadvertently connect an accessory to the wrong jack—it won't fit. Also, Yaesu provides detailed wiring pinouts for all the connectors, in pictorials large enough to read without a magnifying glass, on page 11 of the standard Operating Manual. And they supply every single connector you might need with the radio. (The only connectors not supplied are those which are prewired onto their unique accessories. If you don't buy the Yaesu accessories, you'll have no need for these plugs.)

The Receiver

There's a lot more to brag about with the FT-900. The rig's receiver employs “up conversion” (the 1st IF at 70.455 MHz is above the tuning range of the radio), like most modern rigs, to allow wide frequency coverage and reduce undesirable images. The 70 MHz 1st IF is shaped by two crystal filters (XF2001, XF2002) before amplification and conversion to the 8.125 MHz “notch” IF or the 455 kHz final IF. The second and third mixers are 3SK131 dual-gate MOSFETs and all injection frequencies are controlled by the rig's “LOCAL UNIT,” a DDS system containing four separate VCOs (low-noise 2SK210 JFETs) to tune from 100 kHz through 30 MHz. The narrowest filtering occurs in the 455 kHz IF stage, where two field-replaceable (solder-in type) SSB/CW filters, as well as the 6 kHz AM and 8 kHz FM filters are located. The “standard” 455 kHz IF filters are ceramic, while the narrower-bandwidth optional filters are crystal types.

The IPO (Intercept Point Optimization) switch performs the same function as Kenwood's AIP (Advanced Intercept Point) switch: It bypasses the receiver's dual 2SK125 JFET front end (RF preamplifier stage) and routes received signals directly to the active, balanced (quad of 2SK125s) first RF mixer. This is handy on the bands below 10 MHz, where signals can be quite strong and the noise figure is unimportant. The ATT (attenuator) switch adds a 12 dB "pad" between the antenna and receiver, but leaves the preamplifier stage active. Using either or both of these controls should eliminate almost any receiver overload situation, but may reduce sensitivity to the point where weaker signals just can't be heard. Unless you live very near a powerful shortwave broadcast station or use large gain antennas on high towers from a home station, receiver overload should not be a problem. (Overload when operating mobile is almost never a problem.) I'd like to see more receiver dynamic range (extended on the high end of the scale) and fewer Band-Aids to patch up inadequacies, but unfortunately the designs and devices required to significantly improve HF receiver dynamic range can be too costly to include in amateur-grade equipment.

The FT-900's receiver noise blanker (NB) operates in the 455 kHz IF and is activated by a single push-button on the subpanel. It does a reasonable job of reducing ignition noise pulses, but does not have any "threshold" or "width" adjustment as some of the more sophisticated base-station rigs do. The main job of a blanker in a mobile rig is to reduce intrusion of ignition noise pulses, and this blanker is adequate. For enhanced noise reduction in base-station operation, you might consider one of the popular digitally-processed noise reduction filters on the market.

The little Yaesu contains two good QRM-fighting tools which work well: The IF SHIFT adjusts the IF bandpass above or below the center of the IF, thus shifting response around the desired signal. The IF NOTCH filter operates in its own 8.125 MHz IF stage and allows adjustment of a steep (30 dB) IF notch within the IF passband, tunable about 1.2 kHz above and below the IF center frequency. Both functions are similar to those found in many modern HF rigs. The standard (SSB) ceramic IF filter is perfectly adequate for most operation. Yaesu offers an optional, sharper, crystal IF filter (XF-110S, $155) with steeper "skirts" (4.4 kHz @ -85 dB or so, compared with the standard filter's response of 4.4 kHz at -70 dB) for those who may benefit from the additional strong adjacent-signal rejection. Both filters have about 2.6 kHz bandwidth at -6 dB, which leads to nice-sounding audio from both the transmitter and receiver in the SSB mode. (See the note below regarding the TS-50S comparison.) There are two optional CW filters available for the '900, the XF-110C 500 Hz and the XF-110CN 250 Hz, which sell for $149 and $155 respectively. I found in using the XF-110C that it is much sharper than the SSB filter, but not nearly as sharp as the 500 Hz crystal filter in my old (1978 vintage) Drake TR-7. (Not that this is a fair comparison: The TR-7 cost over $2,000 16 years ago. By today's standards, it would be a $4,000 rig. And it couldn't possibly fit in my car!)

A feature of the '900's that CW ops will like is the "Reverse CW Sideband" function. This feature, accessed by depressing and holding the FAST button, then depressing CW, activates a special display screen indicating the sideband carrier injection "side" (U for "upper," L for "lower"). Rotating the main tuning knob allows the operator to revise the injection frequency (U to L, or L to U), thus altering the way stations are tuned in on CW. This can be a good QRM-fighting tool: If the rig is set up for "U"-side injection and you have severe QRM above the frequency of the station you're trying to receive (and within or near the IF passband), you can switch the injection to "L" and make the interference literally disappear. A combination of switching sideband injection, plus using the IF SHIFT control, works well in suppressing interference that would otherwise be impossible to contend with. My four-year-old TS850S/AT has exactly this same feature, and at the time it was introduced was the only HF ham rig on the market to offer this. The FT-900 is the first mobile-type rig I've seen with reversible CW sideband injection, and I hope others will follow. It works!

CW BFO Offset ("Pitch") is also adjustable in the FT-900. The factory default offset is 700 Hz, but if you prefer listening to higher or lower-pitched CW signals, you can alter the offset from 400 Hz to 1,000 Hz. To remind you of the offset you've selected, the CW sidetone produced by the speaker or headphones tracks the offset. In this way, when you tune in a station so his CW "pitch" sounds the same as the sidetone frequency, you are exactly zero beat with that station. The CW BFO Offset is another function activated by a "FAST" button combination: In this case, it's FAST, plus ATT.

The Transmitter

The FT-900AT's transmitter is impressive. It delivers about 100 watts output into a 50 ohm load (see the sidebar for actual test data), and then goes a bit further by delivering nearly 100 watts output into some common mismatches, even without employing the ATU. For example, while the FT-900AT tested produced 100W output into my Bird "Termaline" model 8201 coaxial resistor (a perfect load up to 1 GHz) at 7 MHz, it also produced 100W output into an antenna having a 2:1 measured VSWR, and didn't begin to "drop off" in output power until the VSWR exceeded 2.5:1. Using the internal ATU, the 2.5:1 antenna (a CW-tuned dipole operated at the high end of the 'phone band) mismatch was perfectly corrected, and the output power increased again. I found a similar situation to exist on every band—the transmitter did not fall off significantly in output power until the measured VSWR exceeded 2:1. This is better than many radios I've seen where output power begins falling off rapidly with any mismatch at all. It might allow many users to get along without the optional internal tuner (ATU-2, $239) or the more fancy optional external tuner (FC-800, $429), especially if operation only with resonant base-station antennas is intended.

Perhaps a brief circuit description of the FT-900's power amplifier stage is in order, and will help us understand how the rig seems capable of nearly constant output power over a wide range of terminating impedances. The rig's "100W PA UNIT" appears to develop about 26 dB gain using three cascaded stages: The first PA driver is a 2SC2166 in common-emitter, with slight degeneration and gain peaking by a 3300 pF capacitor across its 2.7 ohm emitter resistor. The PA driver stage is a pair of push-pull 2SC3133s, with emitters grounded and base bias regulation provided by an IC 8V regulator (uPC7808H). This stage drives the final pair of push-pull 2SC2879s via a 4:1 toroid transformer. The final PA's base bias is supplied by a 2SD882 series regulator and is adjustable. The PA's output is fed to the "LPF UNIT" via a 1:16 toroid transformer which matches the 3 ohm collector impedance of the PA to the 50 ohm filter impedance. The LPF UNIT contains six relay-switched low-pass filters: one each for 160, 80 and 40 meters, plus one each for 30/20m, 17/15m, and 12/10m. Each filter is a pair of pi-sections with tuned series elements and slight imbalance to achieve broadband impedance matching. The output from the filters runs through a directional coupler sampling both forward and reflected power. These detector outputs are fed to both the rig's bar graph display and the "TUNER-CNTL-UNIT" to provide tuning status data.

The +13.5 VDC line to the entire PA unit is relay-switched by a PTT signal, so no bias is provided to the PA stages on receive. Final PA collector current may be measured using a 1 volt full-scale meter connected between two test points (TP4001, TP4002), and 0.5V means 20A collector current. The entire design is robust, and the only changes I would make if drafting it myself would be to eliminate the switching relay (and use solid-state cutoff bias switching instead); adding another set of test points to allow monitoring the individual collector currents of the two final transistors; and making the final stage bias individually adjustable, so that matched pairs of transistors would be unnecessary.

The FT-900 uses a ducted-air cooling system and very large heat sink to keep its power amplifier transistors cool, and its internal fan is thermostatically controlled to operate when needed. I found that a few minutes of transmitting at full power, either SSB or CW, caused the fan to come on. It's quiet enough that you won't notice it when using headphones, and you'd never hear the fan in a mobile installation (especially with the rig mounted in your trunk!), but it might be slightly distracting if operating with the speaker. Yaesu recommends running at reduced power (50W) for continuous-duty modes such as RTTY or FM, especially in hot or humid weather.

Transmitted audio reports were very good, as were reports on keying when using CW. As usual, I got mixed reviews regarding the speech processor (which operates in the transmitter's IF stage): Some stations contacted said the rig sounded better with the processor on, while others said it sounded better with the processor off. This is pretty typical. The rear-panel COMPression level adjustment and front-panel MIC GAIN control do interact a bit, and both are probably best adjusted by listening with headphones on a separate receiver. The ALC level bar graph display is also a handy tool for making these adjustments. The FT-900 does not contain a "monitor" function which allows listening to one's transmitted audio. I'll admit I miss that feature, as I find it handy on my TS-850S/AT and other "base station" radios I've used. With the FT-900 and most other ham rigs, it never pays to adjust the mike gain or compression level so high that the ALC meter runs above its "normal" range. Too much mike gain makes anyone sound bad and increases background noise. Excellent examples of "too much mike gain" can be found on the bands daily, unfortunately.

The FT-900's speech processor has a frequency-shift feature, which allows shifting the IF passband of the transmitted signal in the SSB mode "to customize your signal for your own voice characteristics" (to quote the manual). The processor offset is adjustable from -300 to +500 Hz; a minus sign (negative shift) emphasizes lower-frequency speech audio, while a plus sign (positive shift) emphasizes higher-frequency modulation. Yaesu recommends starting out with a +100 shift, to add "crispness" to your processed speech. This seemed to work fine for me. The adjustment is performed by pressing and holding the FAST button, and then the PROC button. The display then indicates the precise processor frequency shift, which can be adjusted by turning the main tuning knob. To return to normal operation, you just press the PROC button once more. Easy!

Operating

As with most modern digital radios, the FT-900 has a variety of menu functions. I've already discussed a few of the "FAST" setup functions (used by depressing the FAST key plus one other key, while the radio is already powered up). There are 11 FAST button combinations, plus another 11 power-up functions. These are functions activated or toggled in status by depressing one front-panel key or another while turning on the radio. For example, to disable the beeper confirmation tone generator (which beeps every time you depress a front-panel key), just hold down the NOTCH key while turning on the radio. To adjust FM repeater offset ("shift," which has a 100 kHz factory default), depress FM while turning on the radio; this brings up a "shift" display, which can be altered in 1 kHz increments, using the UP or DOWN keys. These are just two of the power up functions. The other nine are similarly useful.

Almost all QSK (electronic break-in) radios can also operate in the "semi-QSK" mode. This is often required when using an outboard linear amplifier, since most cannot support full break-in operation. In many rigs, you must remove a top or bottom cover to locate a switch that activates a relay for keying an outboard amplifier, and from that point forward you've lost full-QSK capability until the switch is returned to the "off" (QSK enable) position. Not so with the FT-900. This rig has such a switch, but it's located on the bottom of the radio and can be accessed through a hole in the bottom cover. No covers nor screws need be removed to enable or disable the amplifier keying relay. You could easily flip this switch a dozen times a day, and not mind it. Another easy adjustment can be made to the sidetone and beeper volume control, which is accessible through a hole on the left side-panel of the rig. No covers need be removed to make this adjustment, either. Very thoughtful!

Another interesting feature of the FT-900 is the RIT "Clarifier" (CLAR) tuning range and operation. The CLAR tuning range is +/-9.99 kHz (a very wide range indeed!) and its tuning steps are adjustable by 2.5, 5.0 or 10.0 Hz increments. The factory default increment is 5 Hz, which makes the CLAR tune awfully slowly. I immediately changed it to 10 Hz, which makes the control tune faster but still have enough resolution for easy use. The CLAR works independently for each VFO, each band, and each of the 100 memories. It may be turned "on" and "off" by a separate push-button, but the CLAR has no center detent to remind you when you've returned to zero offset.

The ATU-2 automatic antenna tuner works well and is easy to operate. However, the simple circuit (six fixed and two variable capacitors, seven inductors, 14 relays controlled by a microprocessor TUNER CNTL UNIT) can take quite a long time to "find" a suitable match under some conditions. I tried using a 190-foot long, center-fed doublet (fed with 450 ohm "ladder line" and a matching transformer coupling to a long coaxial feedline to the shack) as a test antenna, presenting varying impedances and phase angles to the FT-900AT's antenna jack. On some frequencies, the ATU-2 found a match very quickly, in a second or two. On others, it was still searching after nearly 30 seconds—although even in these cases it did not give up, and did finally find a match point. Thirty seconds is a long time to wait for an automatic tuner, but is still faster than manual tuning. I tried the same test doublet on my Kenwood TS850S/AT base station rig, and it found a match considerably faster on those frequencies that were troublesome for the ATU-2. The TS850's ATU RF circuitry is not terribly different from the Yaesu ATU-2's, so the difference might be in the firmware. In any case, once the '900AT finds a good match, it retains that data in one of its 31 tuner memories which compare tuner settings to operating frequency. If you always use the same antenna for each band, the memories will automatically operate the tuner as you change bands and frequencies and make rapid QSY much easier. However, if you change antennas on each band (say, you use two antennas for 20m, three for 40m, and so forth), the tuner memories cannot do their job. This problem is not specific to the FT900AT; all the ATUs work this way.

The FT-900 contains (standard) a full-featured internal iambic keyer for CW enthusiasts, and it works well. The keyer has dot:dash weighting control, "defaulted" at 1:3. If you wish to change this, you may do so with another FAST function (FAST + IPO brings up a "weighting" display). I found the internal keyer delightful to use, but wish it had storage (memories). Still, not bad for a mobile rig!

Note: A local buddy (Gary KO6GT) owns a Kenwood TS-50 HF mobile rig and we thought it would be fun to compare the FT-900 to the TS-50, considering that the little Kenwood may be the '900's only real competition for the mobileer market. The TS-50 is not available with an internal ATU, and lacks many of the sophisticated panel controls of the FT-900; however, it is a good working radio that has been well-received by mobile/portable enthusiasts, and some even use it as a base station. We set up the TS-50 and the FT-900AT side by side, with a coaxial switch to rapidly change antennas from one rig to the other. While the TS-50 is an excellent product and the envy of many mobileers, the FT-900 was found to be far more functional in a variety of ways. The FT-900's receiver "sounded" better, to quote Gary, who owns a local recording studio and has an educated ear. The '900 has a tighter standard IF filter, making for less hiss and more signal when tuning around the bands. While both radios were more than capable of digging down in the dirt for weak signals on the higher bands (21-28 MHz), signals sounded a bit more readable on the FT-900. In my opinion, this was due to a combination of factors, including narrower IF filtering, different audio frequency response and a better internal speaker which produced louder-sounding signals. (Note that when "remoting" the FT-900, you lose its internal speaker and must use an external one, which plugs into a recessed jack in its subpanel.) On transmit, Gary's TS-50 actually produced more output power than the FT-900, but he had "goosed" his rig up in output power by making internal adjustments, so this was not a fair test. Despite the field adjustment which produced greater transmitter power from the TS-50 into a dummy load, the FT-900AT produced more power into real antennas which were less than perfect. (None of my antennas are perfect. Just like their owner.) It was an interesting comparison. Gary likes his TS-50 but admitted that he'd rather have the FT-900, and if they were both the same price (they're not), the '900 would "win" in his book. My suggestion, as always, is to try out everything, and make a product selection which is best for you.

This Separation Isn't Painful

The FT-900 front subpanel detaches in about one second and the operation involved could easily be handled by my three-year-old (no chance that I'll let her!). To remote the rig from the subpanel, you'll need to purchase Yaesu's YSK-900 Separation Kit, which retails for a mere $56 and includes a 19-foot cable to interconnect the two, plus a mounting bracket for the subpanel and a set of mounting brackets for the rig's "body." Since the mobile PTT mike plugs right into the subpanel using an 8-pin telephone-type modular plug ("click"—it's in), all you need to add for a neat mobile installation is a speaker (a mini phone jack is in a recessed socket in the rear of the subpanel), and something to mount the subpanel on. Yaesu recommends a gooseneck-type mounting fixture (not supplied), but I think even Velcro strips would work, as the subpanel weighs almost nothing. Yaesu provides a sheet titled "Important Advice on Mobile Installation and Operation," which recommends routing the DC power cable, antenna coaxial cable and subpanel control cable in separate paths (not bunched together in parallel). The DC power cable should, of course, be connected directly to the car battery and not taken from the cigarette lighter or fuse panel. Even following Yaesu's careful precautions, mobile installation should not take more than one hour. I tried it, and had the rig professionally installed in 45 minutes, including routing all the cables under the carpeting (ugh!) and hanging a mike bracket on the dashboard.

Mobiling with the FT-900AT is a breeze. While mobile whips usually don't load up well across an entire amateur band (especially below 20 meters), the ATU helps generate a powerful signal from even modest antennas like my Hustler system. My first mobile contact with the FT-900AT was with JA1LZR in Tokyo on 17 meters. Joe gave me a "56" report. My next contact, with ZP6CW, yielded a "559" report on CW, also on 17 meters. (Yes, I'm one of those nuts who operates mobile CW.) The best part is: I was using a 20 meter whip! (My Hustler RM-20S was all tuned up on 14.150 MHz and had an SWR of greater than 3:1 at 18 MHz. I used it anyway, and the ATU-2 did its job and got me some DX!)

Options and Accessories

I've already mentioned some of the available options for the FT-900. There are others. The TCXO3, a high-stability reference oscillator for the '900 frequency synthesizer, is available for $95. The DVS-2 digital voice synthesizer, capable of recording from the FT900's mike or from its receiver (playing back other hams so they can hear themselves is kind of fun!) retails for $279. The SP6 base-station speaker is $149. The mobile bracket, if you want to mount the radio as one unit without the separation kit, is $29. A sharper SSB IF filter, model XF100S, retails for $155.

While I would opt for a CW filter (XF110C, $149; or XF110CN, $155) because I work a lot of CW, my feeling is that if you load up on lots of accessories to make this a base station, you might be better off with a real full-featured base station rig like an FT-1000. If a small, mobile-type radio could become a wonderful do-everything base-station, then not many FT-1000's would have been sold. On the contrary, lots of FT-1000's have been sold, and this is one of the choice radios for big-gun DXers and contesters. They know what they're doing.

On The Air!

If you've read this far, you know I like the FT-900AT. It's a very worthy radio that would make a great addition to my shack or car (and probably will). But how does it work in real life, on the air? Just great!

See Table 1 for an honest recounting of what I

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- Notch filter
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Specifications are subject to change without notice.
* IBM AT is a registered trademark of the IBM Corporation.

- **Basic display lets you know exactly where you are.**

```
14.03510-T    0930
14.03510-R    M000
```

- **Standard Display shows RX/TX VFO freq's, time and current memory**

- **Send & Receive in: CW / RTTY(BAUDOT) / ASCII**

```
TNX FER QSO. 73
█
```

← **Incoming data**

← **Outgoing data appears here**

- **Store up to nine 256 character messages.**
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```
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3> CANNED     MSG█
```

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FT-900 Measurements

Transmitter:

Rated power output: 100 W (CW, FM) all bands
Measured into 50.0 ohms load (resistive)
VDC = 13.8V

Frequency (MHz)	Max Po (W)	Min Po (W)	Tuner loss (VSWR = 1.0)
1.8	118	2.0	-.34 dB
3.5	110	2.0	-.41 dB
7.0	102	1.7	-.45 dB
10.1	97	1.7	-.52 dB
14.0	94	1.6	-.70 dB
18.1	90	1.6	-.79 dB
21.0	88	1.5	-.87 dB
24.9	80	1.3	-.97 dB
28.0	70	1.2	-.53 dB
29.7	74	1.2	-.91 dB

Measured into VSWR = 2.5:1 (reactive, adjusted phase angle for minimum Pout)
VDC = 13.8V

Frequency (MHz)	Max Po without tuner engaged (W)	Max Po with tuner engaged (W)	Increase in Po with tuner
1.8	42	109	+4.1 dB
3.5	70	100	+1.5 dB
7.0	62	92	+1.7 dB
10.1	100	86	+0.0 dB
14.0	60	80	+1.2 dB
18.1	70	75	+0.3 dB
21.0	65	72	+0.4 dB
24.9	60	64	+0.3 dB
28.0	60	62	+0.1 dB
29.7	55	60	+0.4 dB

Power output bar graph display accuracy test: 50 ohm coaxial resistor load
(Data taken at 21.000 MHz, which averaged errors)

Indicated Power	Actual Power
10 watts	12 watts
25 watts	27.5 watts
50 watts	51 watts
100 watts	92 watts

FT-900 current drain from 13.8 Vdc power supply:
Rx only (standby) = 1.4A
Tx @ lowest power output setting (see chart above) = 4.0A
Tx @ standard "QRP" level for Field Day (5W out) = 5.7A
Tx @ 1/2-power output (50W) = 14.3A
Tx @ maximum power output setting, worst case = 22.9A
% Efficiency, RF power output to DC power consumed:
Tx @ lowest power output setting = 3%
Tx @ 5W output power = 6%
Tx @ 50W output power = 25%
Tx @ full output power = 32%

Receiver:

Rated sensitivity: <0.25 μV for 10 dB S/N (SSB & CW)
0.5 μV for 12 dB SINAD (FM, 29 MHz)
Measured sensitivity: 28.000 MHz was "worst case" and all sensitivity data taken at this frequency.
MDS (minimum discernible signal) = -127 dBm (0.1 μV)
10 dB S+N/N ratio = -118 dBm (0.29 μV)
FM sensitivity MDS = -121 dBm (0.2 μV)
FM sensitivity 12 dB SINAD = -115 dBm (0.4 μV)
FM sensitivity "DFQ" = - 87 dBm (9 uV)
Rated selectivity (-6/-60 dB): 2.2/4.2 kHz (SSB & CW wide)
0.5/1.8 kHz (CW NAR, XF110C)
250/700 Hz (CW NAR, XF110CN)
6.0/18 kHz (AM)
8.0/19 kHz (FM)

Measured selectivity: (Note did not measure CW NAR XF110CN response as this option was not installed)
SSB and CW wide: 2.24 kHz, -6 dB; 3.7 kHz, -60 dB; 7.24 kHz "ultimate" rejection (-87 dB)
CW NAR (XF110C): 500 Hz, -6 dB; 2.3 kHz, -60 dB; 5.5 kHz "ultimate" rejection (-87 dB)
FM: 7.8 kHz, -6 dB; 15.6 kHz, -60 dB
AM: Not tested.

Notch filter performance: 37 dB maximum notch (SSB & CW)

S-meter bar graph display accuracy test:
(Data taken at 10.1 MHz, which normalized readings over all the HF amateur bands.)

S-meter bar graph indication	Actual signal strength dBm/μV
SSB & CW readings	
S1	-104/1.4
S2	-103/1.6
S3	-101/2.0
S4	-98.5/2.7
S5	-95/4
S6	-89/8
S7	-82.5/17
S8	-75/40
S9	-67/100
S9+20 dB	-48.5/850
S9+40 dB	-33.5/5000
S9+60 dB	-17/31000

FM readings: Taken at 28.6 MHz

S1	-105/1.25
S2	-103/1.6
S3	-101/2
S4	-98/2.9
S5	-94/4.5
S6	-89/8
S7	-83/16
S8	-75/40
S9	-67/100
S9+20 dB	-51/630
S9+40 dB	-35/4000
S9+60 dB	-19/25000

Note regarding the FT-900 bar graph output display:
The FT-900 uses a 31-segment LCD bar graph to indicate power output (W) and S-meter readings. This allows very fine resolution for small incremental changes in output or received signal strength and is one of the best bar graph displays reviewed. Its accuracy was equivalent to many of the analog meters found on similar or higher-priced equipment, and of greatest surprise was its "S-meter" accuracy on FM. Most "S-meter" readings on FM receivers, whether the display be analog or digital, are highly inaccurate and might be used for relative indications only; not so with the FT-900, where the "S-meter" readings on FM are almost as meaningful as they are on SSB/CW modes. I wish the VHF/UHF FM equipment makers would find out how to do this! (Data taken by WB2WIK/6 11-23-94)

worked the first day I had the little rig, before I even opened the owner's manual.

The list is actually much longer than this, but you get the idea. I let my nephew, Rob KD6EWT (cover inset photo), a 12-year-old aspiring contester, use the FT-900AT during the ARRL SSB Sweepstakes, the weekend of November 19th. Using the rig "barefoot" with a vertical antenna, and operating only half the contest, he worked 295 contacts in 72 sections, for 42,480 points. He's not much of a phone operator and does better on CW, but he had fun. I asked him how he liked the rig, and his reply was, "Can we buy it?"

Summary

The FT-900 does most things well, and some things superbly. It is not an FT-1000, but then, it doesn't claim to be. It's a well-equipped mobile-portable-Field Day rig that will serve as a good base station for many operators. Small as it is, if you're revamping your station and wish to replace an older-generation HF rig, you're in for a great surprise—the FT-900 will perform rings around many older radios, at a price not much different from the original acquisition cost of the older gear. For mobileers, what can I say? The FT-900 is a bright star shining in the vast darkness created by too-small automobiles and too-large radios. All in all, I loved this rig. ■

Table 1.

10.1 MHz CW:	WZ7L	559 Orem, UT	Steve said it sounded great.
7 MHz CW:	K1TU	579 Houston, TX	Bob loved it.
14 MHz CW:	HI3MTU	599 in Haiti	Quick contact, DX style.
14 MHz CW:	JA2RGH	579 in Aichi, Japan	Aki said "FB radio."
14 MHz CW:	JA1JYZ	589 in Tokyo	Tam liked the keying.
14 MHz SSB:	FJ/K4ISV	58 in French St. Martin	Bud gave good audio report and was enjoying his vacation on the beach.
14 MHz SSB:	N3EUU	57 in Harrisburg, PA	John gave good rpt.
14 MHz SSB:	KB8CQ	59 in Cleveland, OH	Ed liked the audio.
7 MHz CW:	TO0P	599 in Congo QSL via F6BFH!	Worked on first call with pileup.
10.1 MHz CW:	AA0MY	599 in Grand Forks, ND	Foy gave good rpt on sig quality and keying.
18 MHz CW:	7K1LVV	579 in Saitama, Japan	Tohru gave "all OK" on rig.
14 MHz SSB:	K5WUL/M	59 in Richardson, TX	Larry heard me in his car OK, near Dallas—good audio.

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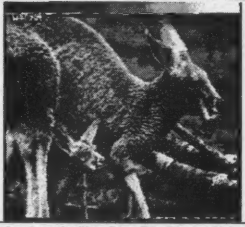

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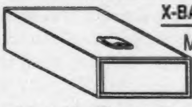

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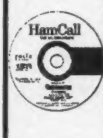

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CIRCLE 56 ON READER SERVICE CARD

Number 5 on your Feedback card

Dual Bi-Square Loop for HF

Try this easy, low-cost approach on 20 and 2 meters.

by Frank Kamp K5DKZ

This antenna design meets two major objectives. It provides an effective and inexpensive 20 meter gain antenna. It also provides a simple single support to elevate a 2 meter ground-plane-style radiator. Both objectives are realized economically, and the entire system can be erected on an average-sized lot. The minimum lot size required is 70 x 70 feet, with the mast situated in the center of the property. Overall dimensional requirements are detailed in the elevation view of the installation, shown in Figure 1. Only one loop is detailed. The other loop is identical and oriented at right angles to the first one.

This implementation is based on the single bi-loop antenna design described by W7CJB in the April 1979 issue of *73*. While the bi-loop was certainly not a new antenna design even in 1979, the earlier article inspired the use of two bi-loops to serve as a means of guying a lightweight wooden structure needed to support a 2 meter antenna. Since the guy wires were needed anyway, it made sense to use them as antennas on HF.

The dual loops allow four-point guying of the mast and provide four directions of HF coverage. The gain of each loop is approximately 4 dB, and compares favorably with small yagi antennas of much costlier and complex construction. Direction of maximum gain is broadside to the loops. Only one loop is used at any given time, depending on what area is being targeted for a QSO. A single coaxial feedline is used for both loops. Switching between the two loops is accomplished by using the simple "wireless" relay switching scheme shown in Figure 3. The antenna switching relay is mounted on the mast at the feed points to the loops. It is protected from the weather by a plastic housing salvaged from an old Archer-brand mast-mounted TV antenna amplifier. Most any small plastic container could also provide protection. The only caution here is not to attempt a hermetic seal on the container. It needs to be raintight to keep water out, but the bottom should be ventilated to prevent condensation inside the housing.

For output power levels under 500 watts, RG58 coax will work well as a feedline. Since the wire loops also act as guy wires, they should be made from wire that is heavy enough to do the job. As a minimum, hard-drawn #12 copper should be used in the two legs of each loop that carry the full guying load. Note that the wire loops only provide about a third of the material for each of the four guys. The remainder of the guy is made from nylon or Dacron rope. The rope may be tied directly to the wire loops at the proper points or insulators may be used, but don't substitute wire guys for the rope. The 18-foot 3-inch dimension of each side of the loops is critical. It is important to ensure that the upper sections of each guy are also 18 feet, 3 inches long. Keeping these dimensions accurate will ensure that the loops remain square and resonant. Deviations from a true square configuration will result in loss of gain.

The mast may be roof-mounted or ground-mounted, but roof mounting provides additional height and allows us to use a slightly shorter mast. For roof mounting, a mast height of 39 feet will allow us to secure the lower points of the loops at roof level using insulators. Ground mounting will require a minimum mast height of 45 feet to keep the lower parts of the 20 meter antenna at least 6 feet off the ground. Roof mounting is recommended as the easier installation.

A metal push-up style TV antenna mast will most likely work, but it is costlier and heavier than a wooden structure. There is also the possibility that a metal structure will interfere with the radiation pattern of the

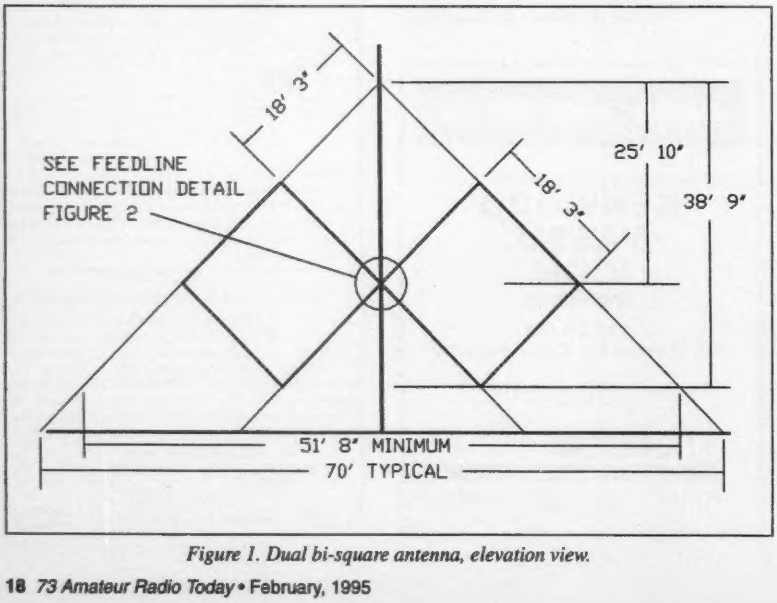

Figure 1. Dual bi-square antenna, elevation view.

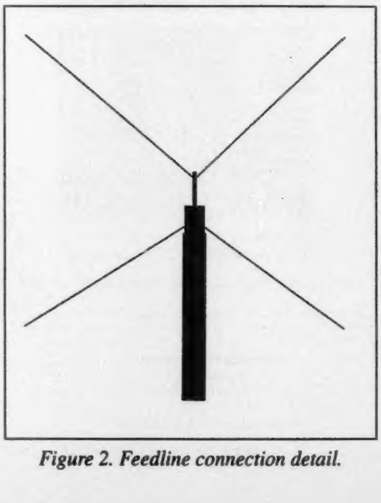

Figure 2. Feedline connection detail.

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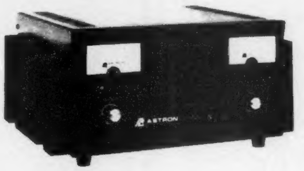
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SL-11R	•	•	7	11	2⅝ × 7 × 9¾	12
SL-11S	•	•	7	11	2⅝ × 7⅝ × 9¾	12
SL-11R-RA		•	7	11	4¾ × 7 × 9¾	13

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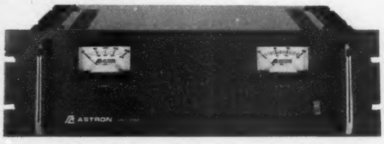
RS-4L	3	4	3½ × 6⅛ × 7¼	6
RS-5L	4	5	3½ × 6⅛ × 7¼	7

RM SERIES


MODEL RM-35M

- 19" RACK MOUNT POWER SUPPLIES

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RM-12A	9	12	5¼ × 19 × 8¼	16
RM-35A	25	35	5¼ × 19 × 12½	38
RM-50A	37	50	5¼ × 19 × 12½	50
RM-60A	50	55	7 × 19 × 12½	60
• Separate Volt and Amp Meters				
RM-12M	9	12	5¼ × 19 × 8¼	16
RM-35M	25	35	5¼ × 19 × 12½	38
RM-50M	37	50	5¼ × 19 × 12½	50
RM-60M	50	55	7 × 19 × 12½	60

RS-A SERIES

MODEL RS-7A

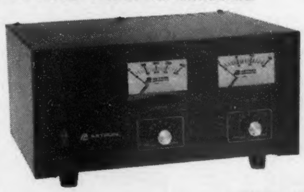
MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-3A		•	2.5	3	3 × 4¾ × 5¾	4
RS-4A	•	•	3	4	3¾ × 6½ × 9	5
RS-5A		•	4	5	3½ × 6⅛ × 7¼	7
RS-7A	•	•	5	7	3¾ × 6½ × 9	9
RS-7B	•	•	5	7	4 × 7½ × 10¾	10
RS-10A	•	•	7.5	10	4 × 7½ × 10¾	11
RS-12A	•	•	9	12	4½ × 8 × 9	13
RS-12B		•	9	12	4 × 7½ × 10¾	13
RS-20A	•	•	16	20	5 × 9 × 10½	18
RS-35A	•	•	25	35	5 × 11 × 11	27
RS-50A	•		37	50	6 × 13¾ × 11	46
RS-70A	•		57	70	6 × 13¾ × 12⅛	48

RS-M SERIES

MODEL RS-35M

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
• Switchable volt and Amp meter				
RS-12M	9	12	4½ × 8 × 9	13
• Separate volt and Amp meters				
RS-20M	16	20	5 × 9 × 10½	18
RS-35M	25	35	5 × 11 × 11	27
RS-50M	37	50	6 × 13¾ × 11	46
RS-70M	57	70	6 × 13¾ × 12⅛	48

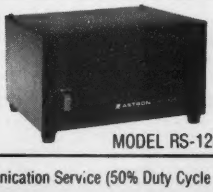
VS-M AND VRM-M SERIES


MODEL VS-35M

- Separate Volt and Amp Meters • Output Voltage adjustable from 2-15 volts • Current limit adjustable from 1.5 amps to Full Load

MODEL	Continuous Duty (Amps) @13.8VDC	Continuous Duty (Amps) @10VDC	Continuous Duty (Amps) @5VDC	ICS* (Amps) @13.8V	Size (IN) H × W × D	Shipping Wt. (lbs.)
VS-12M	9	5	2	12	4½ × 8 × 9	13
VS-20M	16	9	4	20	5 × 9 × 10½	20
VS-35M	25	15	7	35	5 × 11 × 11	29
VS-50M	37	22	10	50	6 × 13¾ × 11	46
• Variable rack mount power supplies						
VRM-35M	25	15	7	35	5¼ × 19 × 12½	38
VRM-50M	37	22	10	50	5¼ × 19 × 12½	50

RS-S SERIES


MODEL RS-12S

- Built in speaker

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* Amps	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-7S	•	•	5	7	4 × 7½ × 10¾	10
RS-10S	•	•	7.5	10	4 × 7½ × 10¾	12
RS-12S	•	•	9	12	4½ × 8 × 9	13
RS-20S	•	•	16	20	5 × 9 × 10½	18
SL-11S	•	•	7	11	2¾ x 7⅝ x 9¾	12

*ICS—Intermittent Communication Service (50% Duty Cycle 5min. on 5 min. off)

CIRCLE 16 ON READER SERVICE CARD

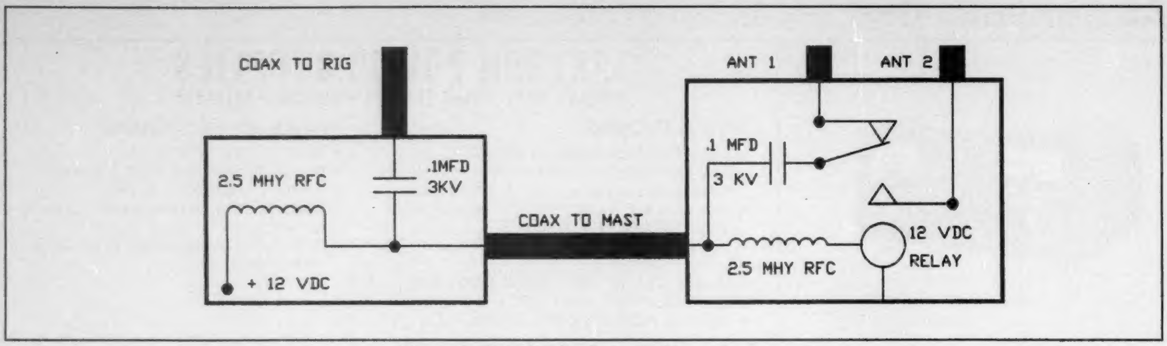


Figure 3. "Wireless" relay switching scheme.

loops. A simpler and less expensive solution is to use 2 x 2 lumber. My installation makes use of a 20-foot length of treated 2 x 6 lumber that has been ripped on a table saw into three 2 x 2 sections. Don't rely on the pressure treating of the lumber as the only protection from the elements. It also needs a couple of coats of varnish or a good grade oil base paint. The actual construction of the mast is detailed in Figure 4.

The primary objective of this project was to obtain maximum results from a minimum of expense and moderate effort. The 3 dB gain 2 meter vertical that was mounted at the top of the mast now allows reliable coverage for local repeater and packet work. The 20 meter bi-loops pick up very little QRN or manmade noise. Compared to other vertically polarized antennas, they are a pleasure to use. SWR over the entire 20 meter band is less than 1.3:1. Directivity switching is instantaneous and the patterns are similar to the clover leaf pattern of phased verticals easing the deep nulls resulting from a single bi-loop.

Although not obvious from Figure 1, the length of the top guy is 54 feet 9 inches (18' 3" times 3). This is a little short for a full-sized 75 meter inverted vee, but we could squeeze in an 80/40 meter trap dipole with ease. It's also a good dimension to use with open wire line and an antenna tuner. Since the mast is not metal the open wire line can simply be attached to the mast with standoff insulators resulting in a neat and proper installation. ■

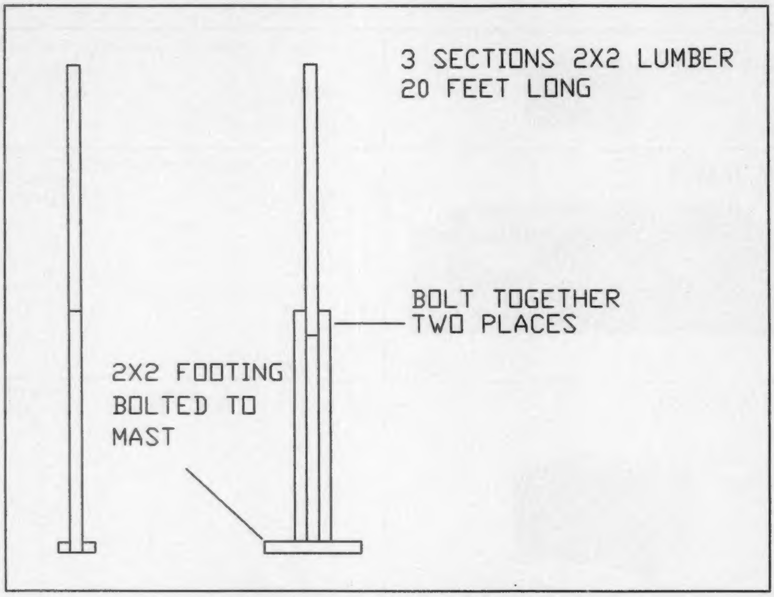


Figure 4. Inexpensive lightweight mast.

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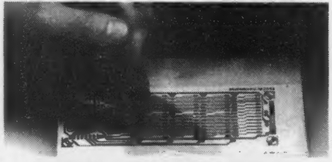

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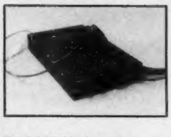

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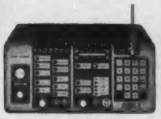

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CIRCLE 34 ON READER SEVICE CARD

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Reading Morse Code on your PC

Decipher Morse code right off the air or improve your own fist.

by Robert L. Kurtz W6PRO

[Editor's Note: The following article is an updated and improved version of the author's November 1978 article "World of the Brass Pounders," published in the Wayne Green publication, Kilobaud. *The original idea was based on the 6502 microprocessor, but here the author has adapted his idea to the popular PC family of computers.]*

How good is your CW "fist?" Are your CQs being ignored? It could be your sending. If you have a PC, here is an easy way to check. This simple program for the IBM PC decodes Morse code and prints the output on a PC screen or printer. I wrote this in 1977 for the early KIM computer and recently updated it for the IBM-compatible family. Simply enter this BASIC program and connect your key or keyer to the parallel printer port of your computer.

The program can also be used to decode Morse directly off-the-air. Included in this article is an interface circuit to connect the headphone audio output of your receiver to your computer. With today's fast computers, the program will follow keying speeds well above 40 to 50 words/minute.

Even though the program looks simple, it has some unusual surprises, such as self-adaptive adjustment for changes in code speed. In addition, the influence of changes in dash or dot length is weighted so that they must occur five or six times in succession before the computer decides that there has been a bona fide speed change. As a result, an occasional "bad" character will not mess up your copy; the printout is extremely stable and the copy is relatively foolproof. The program also detects the end of the word and prints out a space, if required.

Loading the Program

Run BASIC on your computer (we used GWBASIC) and type the program exactly as written—with the proper line numbers, etc. Lines 10, 60, 110 and 150 instruct the program to inspect the main parallel port at Hex 379, and the "AND 8" assures that the computer is only looking at pin 15 of the connector, to see whether or not this is grounded. The program assumes when a dot or a dash occurs, a logic 0 appears on pin 15. This is in agreement with a "keydown" shorting pin 15 to pin 18 (ground).

Program Description

Figure 1 is a simplified flow diagram of the program. The initialization routine (lines 1 through 6) sets the lookup table that will permit the printout of the proper character. The program then waits for a keydown to occur (lines 10 and 11). The first part of the operating program (lines 20 through 70) measures the length of time that the key is down and compares this with the stored value for the length of a dash.

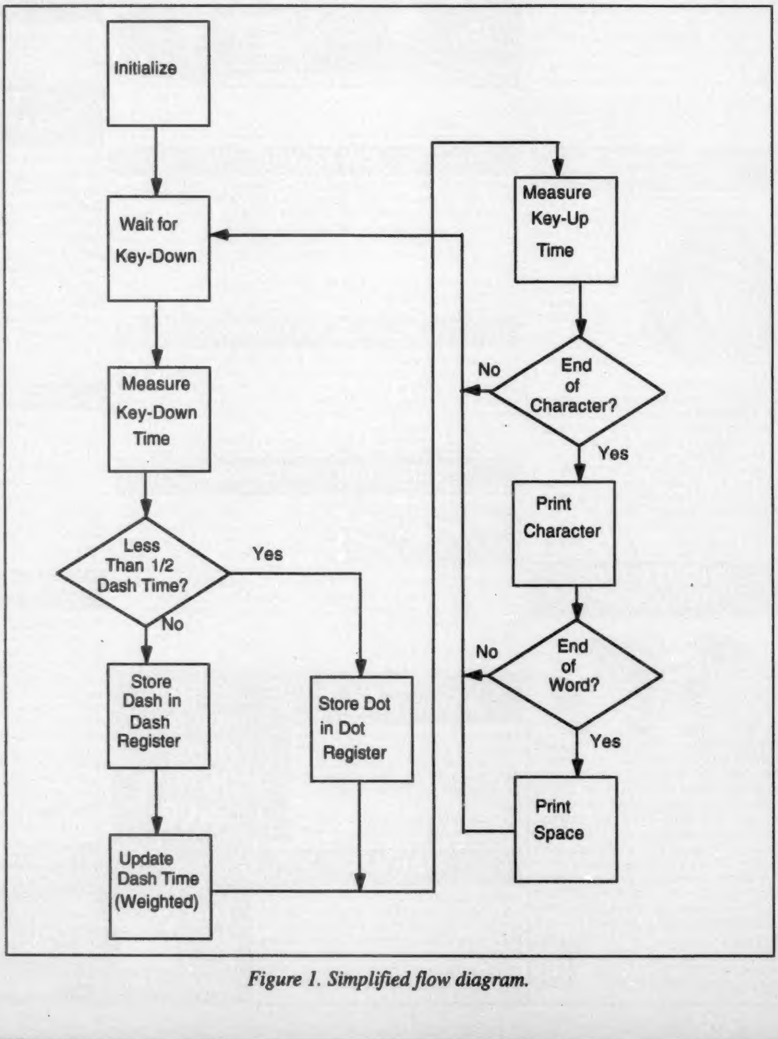

Figure 1. Simplified flow diagram.

If the key is raised in less than one-half of

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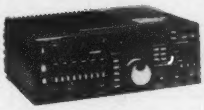

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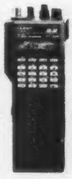

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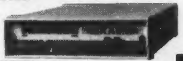

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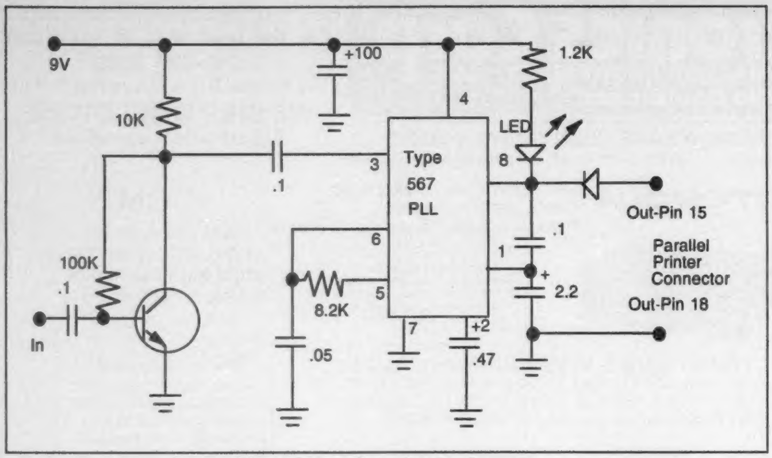
9V
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Connector
1
100K
+
.1
5
2.2
8.2K
Out-Pin 18
In
7
+2
.05
.47

Figure 2. Interface circuit schematic.

the stored dash time, the computer writes a "dot" into the dot register (line 30) and goes to the second part of the program.

If the key remains down longer than one-half of the stored time, a "dash" is stored in the dash register (line 50) and the stored dash time is updated with a one-to-four weighting (line 80). This is accomplished by multiplying the old value of the dash time by four, adding the new value, and then dividing by 5. As a result, the stored value cannot change drastically from character to character, and the copy is not susceptible to errors from erratic sending habits.

The second part of the program measures the length of time that the key is "up." If it's up less than one-half of the dash length, the program assumes that the character is not complete and no printout is provided (lines 100 through 130). If the key is up longer, the program jumps to line 300, the print-character subroutine. If the key is up longer than twice the dash length, the program assumes that a word has been completed and a "space" is printed (lines 170 and 180).

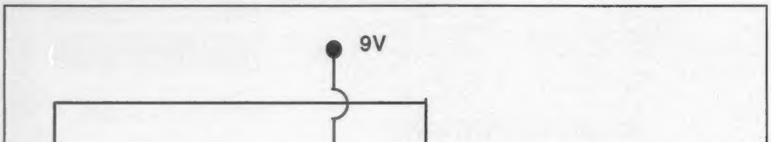

9V
.05
100K
To "Out" of interface circuit.

Figure 3. Audio oscillator schematic. This optional circuit may be used to regenerate audio signals from "CW" processed by the interface circuit board. Connect the input of the board to the receiver, and the output to this audio oscillator. The interface board will key the audio oscillator for QRM-free CW.

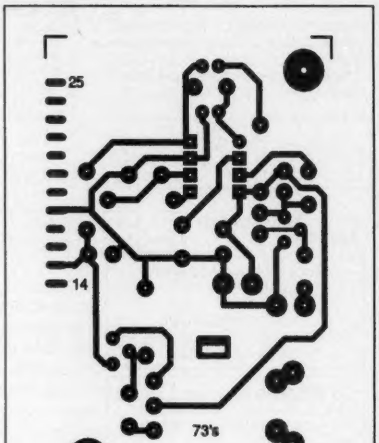
Lookup Table

The heart of the program is the algorithm that counts the dots and dashes and develops a number used to look up the actual character to be printed. In other words, each combination of dots and dashes in Morse code has a discrete number that commands a given character to be printed. This algorithm has three conditions, as listed in Table 1.

Steps 1 and 2 keep repeating until the character is complete. When the program detects a key-up period longer than one-half of a dash length, it assumes that the character is complete and step 3 is accomplished (lines 300 to 430). The manner in which the lookup number for the letter D is formed is shown in Example 1.

Interface Hardware

As was mentioned previously, to check the program (and your own fist) a key can be connected between pin 15 and pin 18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14
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FAR CIRCUITS
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2.2u
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1.2K
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B
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100u
.47
.1
100K
9VDC
GND
IN
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13
100K
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B
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Figure 4. A drilled and etched PC board is available for $4 plus $1.50 S & H from FAR Circuits, 18N640 Field Ct., Dundee, IL 60118.

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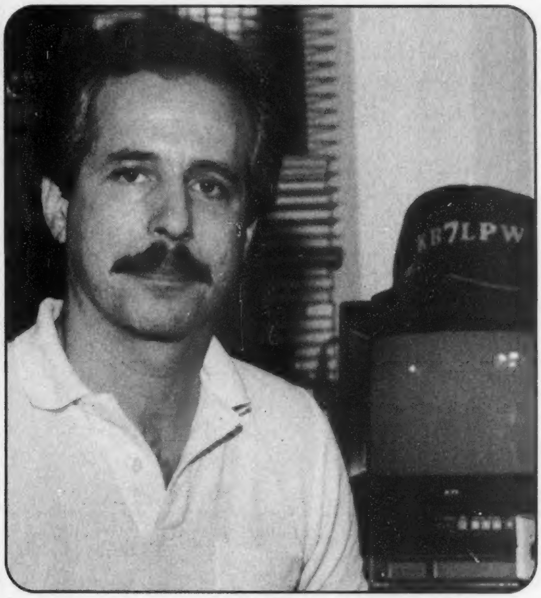

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For sponsorship information contact Ron Cohen at 602-241-0482.

(ground) of the 25-pin parallel connector on the back of the computer.

Figure 2 shows a typical circuit for connecting your radio receiver speaker or headphone audio output to the computer. The NPN transistor is an R/C coupled audio amplifier connected to a type 567 phase-locked loop (PLL). The free-running frequency of the loop is set by the values of the capacitor and resistor connected to pins 5 and 6 of the 567, and is approximately 2,000 Hz. The capacitors on pins 1 and 2 of the PLL adjust the bandwidth to about 100 Hz, and the LED serves as a tuning indicator—that is, it will start blinking when the signal is in the center of this narrow bandpass.

The output signal goes to a logic 0 (ground) when a dot or dash occurs. The circuit shown has appeared in numerous publications; you may have your own favorite circuit that you would like to use. Be sure that the circuit provides a logic 0 when a CW tone appears.

Incidentally, the circuit has another unique application. Since it is only activated by audio signals over a fairly narrow bandwidth, it can also be used to "key" an audio oscillator set to any frequency desired. When Morse CW comes in amidst a jumble of other signals, the PLL picks out the signal you want and keys the audio oscillator . . . and that oscillator is all you hear.

Adjusting the Program

One of the advantages of writing this in BASIC is the ease with which the computation constants can be changed. For example, you may wish to experiment with different algorithms to detect whether a key-down signal is a dot or a dash . . . to take care of swing-fisters. This can be accomplished easily by changing the factor in line 40 from (.5C) to (.25C) or (.75C). By the same token, the constants in lines 111 and 151 can be changed to provide more leeway for the formation of characters and spaces.

Type this short program into your PC, connect your key or bug to the parallel port—and send a page from *73*. Compare the screen print with the original page and you may get a surprise. It could explain why so many of your contacts complain about QSB or QRM!

Type this short program into your PC, connect your key or bug to the parallel port – and send a page from 73. Compare the screen print with the original page and you may get a surprise. It could explain why so many of your contacts complain about QSB or QRM!

Step 1. If the input signal is a "DASH" -

First - double the values in the dot and dash registers.
Second - add a "1" to the dash register.
(see line 50)

Step 2. If the input signal is a "DOT" -

First - double the values in the dot and dash registers.
Second - add a "1" to the dot register.
(see line 30)

Step 3. If the character is complete -

First - double the value in the dash register.
Second - add the dash and dot registers to obtain the look-up number.
(see lines 300-350)

Table 1.

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Reading Morse Code on Your PC

Continued from page 26

```
1 REM MORSE CODE READER - WRITTEN BY R. KURTZ - W6PRO
2 RESTORE
3 CLS: REM CAN DELETE - PUTS CURSOR AT TOP OF SCREEN
4 REM TO SEND DIRECT TO PRINTER - USE  LPRINT  IN LINES 180 AND 340
5 DIM A$(100)
6 FOR N=1 TO 100:READ A$(N):NEXT N
10 A=INP(&H379) AND 8
11 IF A>7 THEN 10
15 B=0
20 A=INP(&H379) AND 8:B=B+10
25 IF A<8 THEN 40
30 C=((5*C)+(2*B))/6:DT=2*DT:DA=2*DA:DT=DT+1:GOTO 100
40 IF B<(.5*C) THEN 20
50 DT=2*DT:DA=2*DA:DA=DA+1
60 A=INP(&H379) AND 8:B=B+10
70 IF A<8 THEN 60
80 C=((4*C)+B)/5
100 B=0
110 A=INP(&H379) AND 8
111 B=B+10
120 IF A<8 THEN 15
130 IF B<(.5*C) THEN 110
140 GOSUB 300
150 A=INP(&H379) AND 8
151 B=B+10
160 IF A<8 THEN 15
170 IF B<(2*C) THEN 150
180 PRINT " ";
190 GOTO 10
300 DA=DA*2
310 D=DA+DT
330 IF D>100 THEN D=100
340 PRINT A$(D);
350 DA=0:DT=0
360 RETURN
400 DATA E,T,I,A,N,M,S,U,R,W,D,K,G,O,H,V,F,-,L,-,P,J,B,X,C
410 DATA Y,Z,Q,-,-,5,4,-,3,-,-,-,2,-,-,-,-,-,-,-,1,6,-,/,-
420 DATA -,-,-,-,7,-,-,-,8,-,9,0,-,-,-,-,-,-,-,-,-,-,-,-,?
430 DATA -,-,-,-,-,-,-,-,.,-,-,-,-,-,-,-,-,-,-,-,-,-,-,-,-
```

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Call Sheila today at
(800) 677-8838 to order your
subscription to Radio Fun.

EXAMPLE: D = — • •

Initial conditions: Dot Register = 0, Dash Register = 0

First interval: Input a dash

2 times dash register	= 2 X 0 = 0
2 times dot register	= 2 X 0 = 0
Add 1 to dash register	= 1 + 0 = 1

Summary - dash register = 1, dot register = 0

Second interval: Input a Dot

2 times dash register	= 2 X 1 = 2
2 times dot register	= 2 X 0 = 0
Add 1 to dot register	= 1 + 0 = 1

Summary - dash register = 2, dot register = 1

Third interval: Input the second Dot

2 times dash register	= 2 X 2 = 4
2 times dot register	= 2 X 1 = 2
Add 1 to dot register	= 2 + 1 = 3

Summary - dash register = 4, dot register = 3

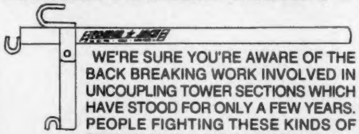
End of Character - determine look-up number for "D"

2 times dash register	= 2 X 4 = 8
Add Dot and Dash registers	= 8 + 3 = 11

Answer: "D" is the eleventh character in the Data file.

Example 1.

HAVING PROBLEMS
TAKING TOWERS DOWN??



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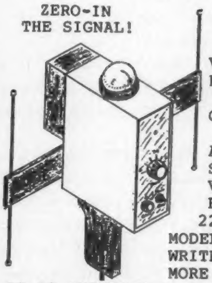

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SAN DIEGO CA.92111

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CIRCLE 75 ON READER SERVICE CARD

73 Review

Number 8 on your Feedback card

by Pete Putman KT2B

Midland International Corporation
1690 North Topping
Kansas City MO 64120
Telephone: (800) 669-4567
Price Class: 18-405 2 meter base station antenna—$99.95 (MSRP)
18-410 dual-band 2M/440 base station antenna—$169.95 (MSRP)

Midland Corporation Models 18-405 and 18-410 Base Station Antennas

Good VHF/UHF performance at a moderate price.

In the June 1994 issue of *73* I took a look at Midland International Corporation's 18-300 series of high-quality mobile antennas for 144 and 440 MHz. At the time, I remember thinking, "Wouldn't it be great if Midland also had a line of base station antennas that worked as well as these and were moderately priced?"

Well, the good news is that Midland does have 'em, and I was able to procure a couple for this review. Both are collinear designs, employing more than one active element driven in series. Both are rugged and easy to put together, and their performance is definitely on a par with the mobile antennas.

18-405 Monoband Base

This antenna can be configured by the user for any band segment between 136 to 225 MHz, although I didn't evaluate its performance outside the 2 meter band. The 18-405 is a fairly lightweight but rugged design, using aluminum element material and stainless steel hardware throughout, and weighing only a couple of pounds. (See Photo A.) The active antenna array uses a pair of 5/8-wave elements with a matching coil in between; an adjustment chart provided by Midland gives you the lengths of each of the four sections, although I tried three different adjustments to get the best VSWR across the 2 meter band.

Stainless steel hose clamps are used to secure the concentric element sections, and after about a year of use they haven't budged an inch. My final and most satisfactory results came with an overall length of 124" (10' 4"), so if you are planning to use an 18-405 make sure you have the vertical clearance! The ground radials are pre-cut at the factory and install into tapped holes on the base of the antenna, projecting out at about 30-degree angles (which is close to optimum for a 50 ohm feed, by the way).

The antenna connectors on the 18-405 and 18-410 look sort of like Type N receptacles at a hurried glance, but they are genuine UHF connectors! A decoupling sleeve which doubles as the antenna mast mount slides over your coaxial cable and is fastened to the antenna's base with machine screws. This permits the installation of a pair of "U" brackets and bolts, offsetting the mast mount on up to 2" mast material. (See Photo B.) This system is great for protecting the coax from inclement weather and will no doubt attract small insects looking for a dry home. Because the two mounting brackets can twist away from each other when tightening, you'll need a level when installing the antenna to ensure it is truly vertical.

Performance

The 18-405 works very well in base station operation, but breaks down into a small enough package that it is ideal for hamfest talk-ins, special events, and even Field Day. As I mentioned earlier, it took a few tries to get the SWR across the band to my liking, but eventually I saw a maximum of about 1.8:1 at 144 MHz with a Bird Model 43, dipping down quickly to under 1.09:1 at 146 MHz and rising back to 1.7:1 at 148 MHz, indicating that the antenna is somewhat narrowband in performance, which is usually a direct consequence of any design to produce higher gain.

In on-air tests, the 18-405 worked about as well as my older F9FT four-element yagi, which has a fairly broad pattern to begin with (-3 dB at 75 degrees). But there's no doubt that it helped me access some fairly distant repeaters with a mere 5 watts from my IC-02AT. At the time, the 18-405 was temporarily fastened to my deck with a couple of bunji cords and sat on a 10-foot mast! Midland claims a gain figure of 7.5 dBi for the antenna, no doubt due to its fairly low radiation angle. While not able to substantiate that

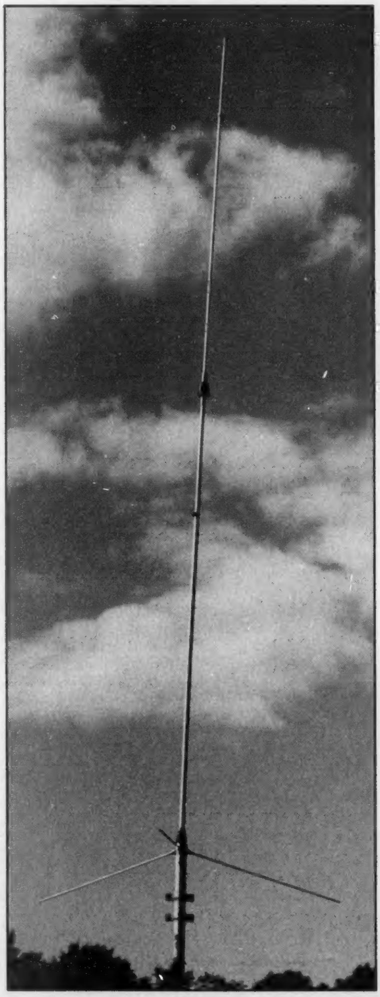


Photo A. The Midland 18-405.

MFJ WINDOWS SOFTWARE

MFJ station automation software finds DX, tunes your rig and does your logging

With a few "point and clicks" of your mouse, this powerful MFJ WINDOWS software helps you . . . find and identify on-the-air DX you need from PacketCuster networks . . . search your log to see if you've worked him before . . . automatically set up and tune your transceiver . . . and work him with pre-stored messages.

And while you're working him, you can . . . log him . . . print his QSL card . . . search and update your awards and contest files.

Logview Windows™, Packet Windows™ and Rig Windows™ are powerful ham radio automation software programs that makes operating fun, DXing competitive and not-so-fun details effortless.

You can use them together as a fully integrated package that unifies your transceiver, packet TNC and logging functions into a fully automated station.

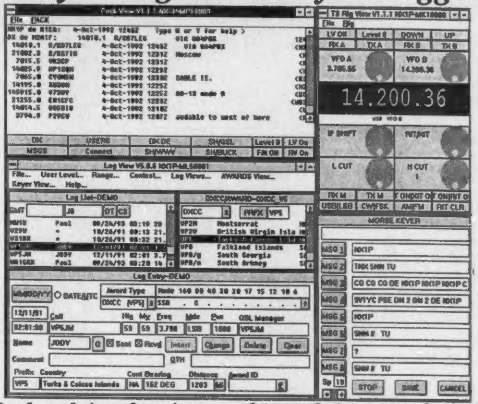
Or you can use them individually as stand alone programs and add other modules as you need them.

Logview Windows™
MFJ-1681
$69.95

Packet Windows™
MFJ-1682
$29.95

Rig Windows™
MFJ-1683K/Y/I
$29.95 *each*

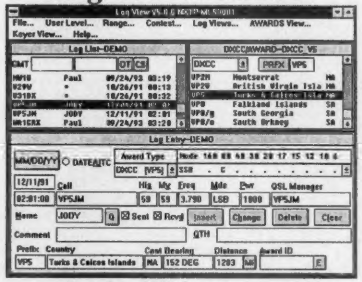
SAVE $20
Complete Package includes all 3 programs above
MFJ-1680K/Y/I
$109.95 *each*



Typical real time logging, packet and rig control windows

Here's an overview of each program . . .

Logview Windows™



```
NW1U    Paul    09/24/93 03:19     VP2M    Montserrat               NA
V29V    *       10/26/91 00:13     VP2V    British Virgin Isla      NA
V31DX   *       10/26/91 00:32     VP5     Turks & Caicos Isla      NA
                                   VP8     Falkland Islands         SA
VP5JM   JODY    12/11/91 02:01     VP8/g   South Georgia            SA
NA1CRX  Paul    09/24/93 03:20     VP8/o   South Orkney             SA
```

DXCC [VP5] SSB . C . . . .
12/11/91
02:01:00 VP5JM 59 59 3.790 LSB 1000 VP5JM
JODY
VP5 Turks & Caicos Islands NA 152 DEG 1203

Logview Windows™ screen

Logview Windows™ is a live real time computerized logbook that gives you instant access to your data.

When you enter a call sign, *Logview Windows™* automatically checks to see if you've worked him . . . if you need him for DXCC or an award . . . calculates distance and bearing so you know where to point your beam . . . for contests it checks for dupes, tells you where you need to make a QSO and its score.

You can scroll through your log in familiar logbook format in either call sign order or date and time order.

For each contact you make, *Logview Windows™* lets you simultaneously update and keep up with dozens of awards such as DXCC, WAZ, OBLAST and WPX. You can attach award identifiers to QSOs for tracking awards.

The Contest Mode gives you fast dup checking and automatic time/serial number stamp. It tells you how many contacts per hour you're making, time past since your last QSO, point score, multipiler score and total score.

Even as you're making your contact, you can be printing a QSL card.

You can choose who to send QSL cards to based on QSOs not confirmed or not sent.

You can print cards or labels in standard format or customized them to suit you. You can print in time or bureau order.

Hundreds of QSO and award reports can be generated. Data from CT and other popular logging programs can be imported.

You can "click on" the built-in keyboard keyer and let *Logview Windows™* help you make QSOs with 8 pre-stored CW messages.

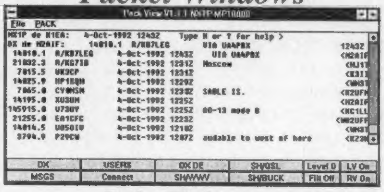
You can set weight and speed and adjust element, character and word spacing. You get a convenient keyboard buffer with on-screen text display for sending perfect CW.

You can automatically add the active call to selected messages -- such as a routine exchange of RST, QTH and name.

You can use beginner levels to get going quickly. When you're ready for more advanced features you can use the expert levels.

MFJ-1681 *Logview Windows™*, $69.95.

Packet Windows™



```
NX1P de K1EA:    4-Oct-1992 1243Z    Type H or ? for help >
DX de N2AIF:      14010.1  R/KB7LEG          VIA UA4PBX                      1243Z
 14010.1  R/KB7LEG      4-Oct-1992 1243Z   VIA UA4PBX                       <N2AIF
 21032.3  R/KG7IB       4-Oct-1992 1231Z  Moscow                            <NJ1T
  7015.5  UK3CP         4-Oct-1992 1231Z                                    <K3II
 14025.9  HP1XQH        4-Oct-1992 1229Z                                    <WN3T
  7065.0  CY0MSN        4-Oct-1992 1230Z  SABLE IS.                         <K2UFM
 14195.0  XU3UM         4-Oct-1992 1225Z                                    <N2AIF
145915.0  U73UY         4-Oct-1992 1225Z  AO-13 mode B                      <KC1LL
 21255.0  EA1CFC        4-Oct-1992 1223Z                                    <WB2UFF
 14014.5  U05OIU        4-Oct-1992 1210Z                                    <WN3T
  3794.9  P29CW         4-Oct-1992 1207Z  audable to west of here           <K22M
```

Packet Windows™ screen

Using *Packet Windows™* and your TNC to access DX PacketCluster™, you can display a list of current on-the-air DX stations.

You can scroll through these DX stations and select one with your mouse. Your rig is automatically tuned through *Rig Windows™* and your logbook is automatically set up through *Logview Windows™* to log your rare DX -- all you have to do is work'em.

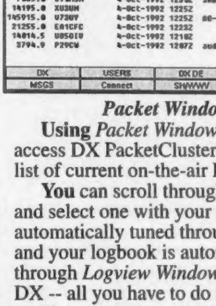
You can select only the DX you need. When they occur, an alarm sounds or you can have their call sent in CW -- you'll know about band openings even if you're in the next room.

For true "hands off" operation, turn on AutoSpot™. When DX you need appears, your rig automatically tunes to his frequency and your logbook automatically sets up to log.

Operating your TNC or PacketCluster™ can be as easy as "point and click" when you use Macro buttons for commonly used commands.

MFJ-1682 *Packet Windows™*, $29.95.

Rig Windows™



Rig Windows™ screen

Rig Windows™ gives you full computerized control of your transceiver. Data from *Packet Windows™* automatically tunes your transceiver to the DX station you want. Frequency and mode is sent to *Logview Windows™* for automatic logging.

Unique mouse operated tuning knobs make tuning as natural as your real tuning knob. You get fine and coarse tuning, separate knobs for VFO A and VFO B plus, frequency and rig status displays.

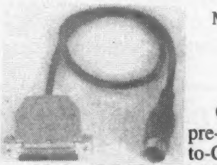
With 48 command macro buttons, you can define and chain them to create complex transceiver control by clicking your mouse.

Separate *Rig Windows™* programs are available for Kenwood, Yaesu and ICOM radios. Each program is customized to make use of features unique to that manufacturer.

For *Rig Windows™*, order **MFJ-1683K** for Kenwood, **MFJ-1683Y** for Yaesu and **MFJ-1683I** for ICOM, $29.95 each.

Requires MFJ-5383K/Y/I transceiver-to-computer interface cable below.

Transceiver-to-Computer Interface Cable has *RS-232 serial interface built-in!*



MFJ-5383K (Kenwood)
MFJ-5383Y (Yaesu)
MFJ-5383I (Icom)
$49.95 *each*

Convenient pre-wired Transceiver-to-Computer interface cable has RS-232 serial interface *built-in!*

Each cable has connectors wired for your transceiver and IBM compatible computer.

Just plug a pre-wired cable into your transceiver and computer serial ports and you're ready for computerized control of your rig through *Rig Windows™*.

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CIRCLE 86 ON READER SERVICE CARD

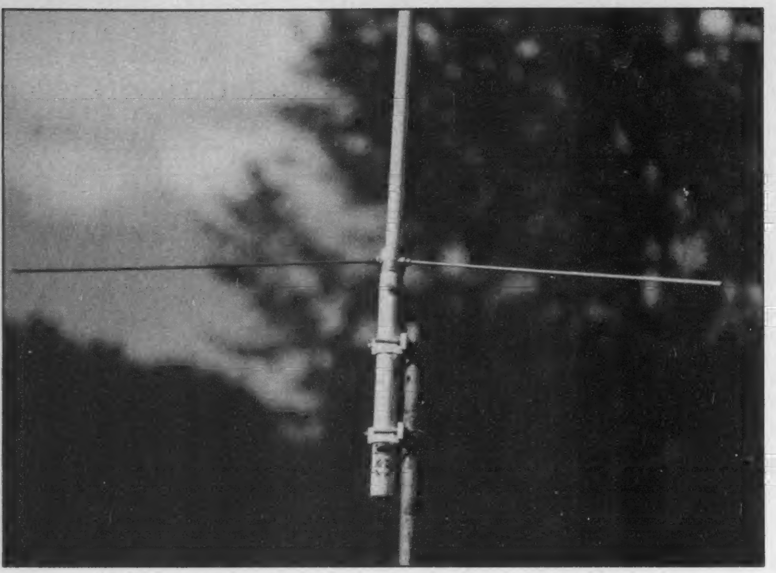

Photo B. The antenna mounting arrangement for the 18-405 and 18-410.

figure, I will say that the 18-405 is a big improvement over the typical 5/8-wave ground plane. By the way, the 18-405 is rated at 200 watts maximum.

18-410 Dual-Band Base

The 18-410 is about as different from the 18-405 as possible in physical appearance and construction. It uses a pair of 5/8-wave collinear elements on 144 MHz and four 5/8-wave elements on 440 MHz, encasing them in a Fiberglas radome sheath measuring 100" (8'4") in length. (See Photo C.) Like its sister antenna, the 18-410 is very light when tipping the scales, but no compromises have been made with the antenna hardware—it's all stainless steel. Unlike the 18-405, the 18-410 comes prealigned from the factory, eliminating the need for "tweaking" the element lengths. You just slide the top radiating section and coil assembly into the bottom, tighten a small screw (don't drop it—I did, right through my element-eating deck) and connect the two sections of the radome with a ferrule and compression nut.

"In a nutshell, the 18-410 was the hit of Field Day '94 for the Warminster ARC. "

The ground plane is provided by the same pre-cut stainless steel radials that thread into the antenna base with a coaxial sleeve nut. Again, the decoupling sleeve and mast support attaches with a single screw to the base and uses a pair of "U" clamps to attach to up to a 2" mast. As before, a level is recommended during installation to be sure the antenna is truly vertical. Wind loading will be somewhat reduced with the 18-410 as it measures over a foot and a half shorter than the 18-405, so don't hesitate to use it as the "star" on your antenna "tree" of beams if you've got a strong rotor.

Since the antenna was "factory aligned," I expected to see fairly good SWR performance. Midland claims under 1.5:1 from 144-148 MHz and 440-450 MHz, so I swept the antenna over this range using a 5 watt RF source and a Bird 43. On 2 meters, I saw about 1.9:1 at 144 MHz, using the suggested settings, dropping to 1.5:1 at 145 MHz and 1.4:1 at 146 MHz. At 148 MHz, I measured 1.8:1, so the 18-410 didn't quite make its factory spec. Should you be concerned about seeing 9% reflected power? Well, I generally disregard numbers under 2:1 as current transceivers and handi-talkies using hybrid power modules are quite happy at this level before power starts to get cut back.

On 440 MHz, the 18-410 exhibited a 1.4:1 VSWR, climbing steadily to 1.8:1 at 450 MHz. Again, the antenna didn't quite match Midland's specs, but the results are certainly nothing to be concerned about. Just for the fun of it, I continued down the 70cm band and swept the antenna at 430 MHz, where I observed 1.4:1 again. The actual "dip," or point of maximum resonance, took place between 434 and 436 MHz where the VSWR measured 1.06:1, indicating that Midland might want to fiddle a bit more with the match on the 440 MHz element. The claimed gain figure for the 2 meter element is 6 dB better than a 1/4 wave, while the 70cm figure is 8 dB better.

Performance

In a nutshell, the 18-410 was the hit of Field Day '94 for the Warminster ARC. Their VHF station needed an omnidirectional antenna for FM work, so being ever the helpful amateur, I offered up the 18-410. It was set up on the top of 30' of Rohn tower sections atop our magnificent site at the Shrine of Cheztohowa near Doylestown, PA. From this 600'+ perch, we were able to work stations up and down the Delaware River valley, well into New Jersey, Delaware itself, and even New York City—a range of over 50 air miles. Of course, having a 100 watt "brick" helped out, but the antenna's performance was impressive nonetheless.

While the 18-410 does have a lower radiation angle than a quarter-wave antenna, its pattern resembles that from a standard 5/8-wave base station. However, the bonus here is that for a comparable antenna size, you get dual-band coverage. For users of dual-band transceivers and HTs, that's good news as the price is reasonable. What's more, the 18-410 also breaks down very quickly for special event and emergency use, making it just as versatile as its sister product for 2 meters. Like the 18-405, its power rating is 200 watts.

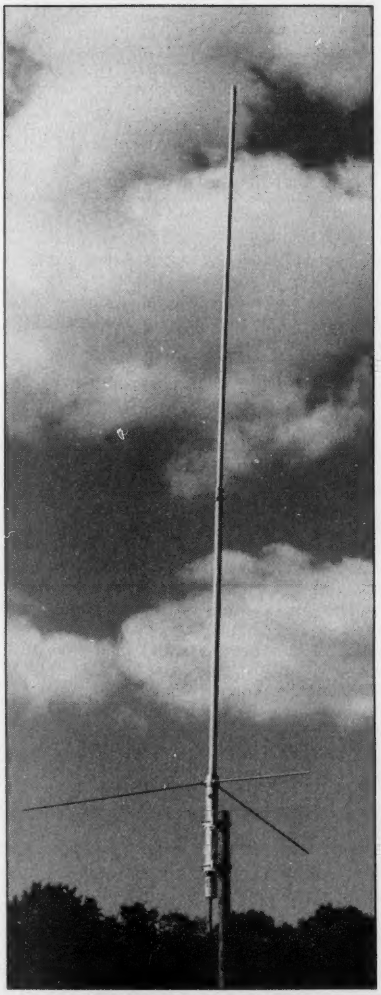

Photo C. The Midland 18-410.

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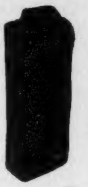

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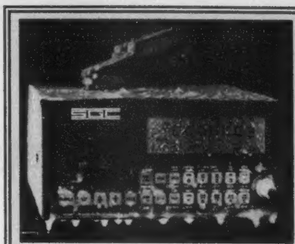

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73 Review

Number 9 on your Feedback card

by Peter Putman KT2B

Down East Microwave DEM 144-28K and DEM 222-28K Linear Transverters

A big step forward in transverter design.

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It seems that more and more equipment for VHF and UHF weak-signal operation is being priced out of the reach of casual operators and newcomers to the world above 50 MHz. Forget what the articles and experts say about "radio equipment actually costing less in today's dollars": $1,500 to $3,000 for a multiband VHF/UHF transceiver is still a lot of money that might be better spent elsewhere. And there's no guarantee that money will buy you top-notch receiver sensitivity, dynamic range and truly linear operation.

The answer for many VHF/UHF enthusiasts has been to use an existing HF radio in conjunction with something called a transverter—shorthand for transmit/receive converter. Transverters convert signals to and from the desired VHF, UHF and even microwave bands to a frequency already present on an existing HF radio. For operation on 50, 144, 222 and 432 MHz, that frequency will typically be 28 MHz, although some designs have down converted to 15 meters and even 20 meters.

What's the Advantage?

Why use a transverter in the first place? For one thing, you retain all of the "bells and whistles" of a radio you're intimately familiar with: that deluxe, 160-10 meter, general coverage radio with IF shift, passband tuning, filter options, memories, multimode operation and (hopefully) a transverter connection on the rear panel. This means your cash outlay becomes more reasonable as you can get on each new VHF band for as little as $300, with a bit of sweat equity, some tools and a soldering iron.

Another advantage of transverters is that their inherent simplicity means that they don't have to take up much room nor use much power. There's plenty of opportunity to experiment with preamplifiers, power amplifiers and antennas as a result of the $$$ you've saved. And if the transverter was built from a kit, you can do your own troubleshooting when problems arise.

Some Brief History

The concept of a transverter is certainly not new. Old ARRL *Handbooks* abound with designs of tube-type linear receive and transmit converters designed to work with 20 meter monoband radios. With a good crystal-controlled local oscillator, frequency stability was assured. And owners of the then-new SSB rigs could experiment with this mode at a minimal cost on 6 meters, 2 meters and above.

To fully realize the reduction in size, however, it took the introduction of solid-state circuits using Field Effect Transistors (FETs) and reliable RF power transistors to perform the up/downconverting, mixing, and amplification functions. Further developments reduced the noise figure of FETs while increasing the gain of both low- and high-level RF amplifier stages. It was during the 1970s that we began to see self-contained "black box" models come on the market, taking as little as 1 mW of drive and producing 10 watts of true linear power.

Perhaps the best known incarnation of this design came from Microwave Modules in England. Thousands of these boxes have been sold since the mid-'70s and continue to sprout up at hamfests across the country. Their simple design and fairly reliable performance made them a good buy at their original prices (between $200 and $300), and they can still be found selling for as little as $100. The original design used a pair of MOSFETS (3N204/40822) as active mixers, combining a low-level 28 MHz signal with an on-board 116 MHz local oscillator. The sum frequency of 144 MHz was then amplified two or three times to 10 watts output.

On receive, a 3N204 or 40673 served as the front end, feeding another 3N204 single-ended mixer whereby the difference frequency (144 - 116 = 28 MHz) was then amplified and fed back to the HF radio. MMTs (as we long-time users liked to call them) were fairly linear devices, but as time wore on their limitations became more evident: the reduced dynamic range of the active mixers, the noise figure of the front end stages (especially at 432 MHz) and the limited power output of 10 watts.

With the demise of Microwave Modules (and its parent, Castle Microwave) in the late 1980s, several industrious hams began tinkering with their own designs, prompted by the availability of low-cost, low-noise GaAsFETS and stable, high-gain MMICs. Down East Microwave, a leading vendor of linear microwave transverters, responded with its DEM 432-28K in 1992 (reviewed in the January 1993 issue of *73*). Here was a high-performance linear transverter, using Avantek GaAs devices in the front end and broadband MMIC mixer/amplifier stages.

Higher power output was realized with a no-tune hybrid power module, resulting in a true no-tune design that was a significant step up from the old MMT 432/28S.

In recent years, Down East has expanded its line by adding a no-tune 50 MHz linear transverter using the same techniques. It was only a matter of time before the 144 MHz and 222 MHz "holes" were plugged with comparable designs, which were shown for the first time at Dayton 1994. (See Photo A.) What makes the DEM 144-28K and 222-28K designs different (and better) than their English predecessors is the use of a passive mix-

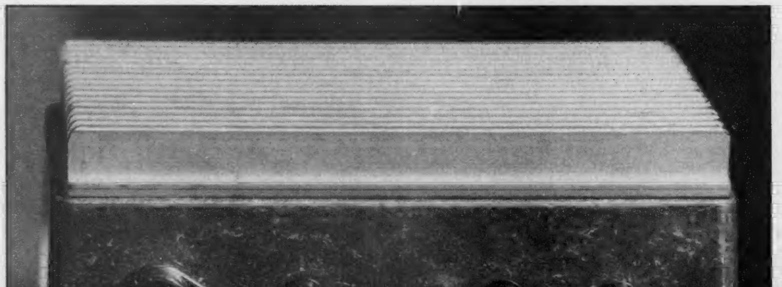

Photo A. A no-tune linear transverter from Down East.

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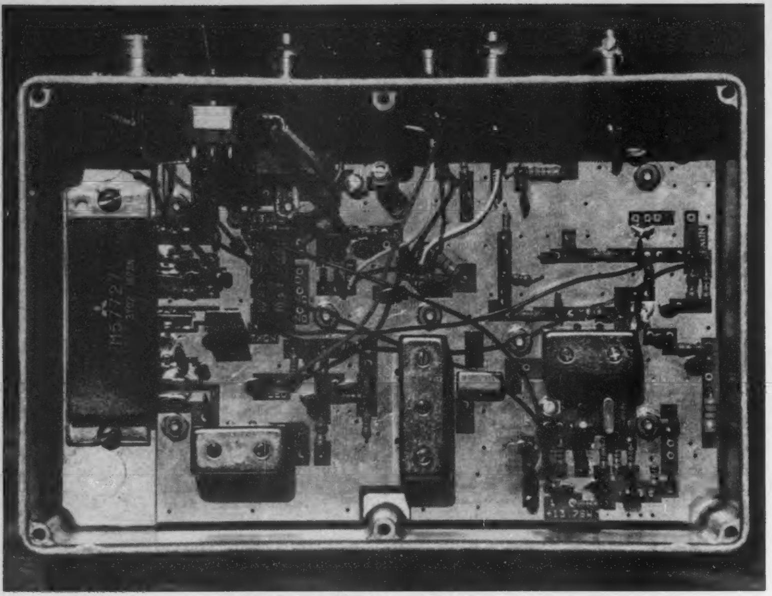

Photo B. The DEM 144-28K transverter.

er design for both transmit and receive conversion. Although there is loss in a passive mixer, the increase in dynamic range more than makes up for it.

On receive, a GaAsFET ahead of the mixer provides plenty of gain at very low noise figures, while MMICs after the mixer help increase conversion gain at 28 MHz to a satisfactory level. 28 MHz transmit signals are processed in the same way, combining with the LO signals in the same mixer and then boosted by a couple of low-level RF stages before the hybrid power module. The only adjustment in either case is the local oscillator trimmer capacitor—everything else just works without tweaking.

DEM 144-28K

This transverter (and its companion design for 222 MHz) are not reworked versions of the DEM 432-28, as was originally rumored. Instead, they are totally new designs from the desk of Steve Kostro N2CEI who distributes many of Down East's products. The goal here was lots of dynamic range in both transmit and receive modes, as well as a stable circuit with very little lumped components (Photo B).

Although both boxes are sold as kits, the amount of assembly work required shouldn't scare anyone off. For one thing, the PC boards are professionally laid out double-sided, G10 epoxy material with plated-through holes.

They've been pre-drilled for all components, filters and mounting screws and notched to fit inside the supplied Hammond die-cast chassis. This chassis has also been drilled for the mounting screws, which thread into pre-tapped wholes in a piece of ribbed heatsink material that attached to the bottom of the box. The mounting holes and taps are also pre-drilled for the Mitsubishi power modules which means all the builder needs to drill out and mount are three BNC connectors, a switch, two LEDs and two RCA jacks. *[Editors Note: All holes are now predrilled at the factory.]*

How They Work

In the 144-28K, low level signals from the 10 meter IF radio are fed through a resistive pad net-

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work and sent to a Mini Circuits TUF-1H passive mixer stage. The transverter is designed to accept signals from 1 mW to 100 mW, but there is a provision on the board for an optional MAR-6 MMIC stage to boost the low transverter drive from certain radios, such as Icom's 740/845/751/735 and later series. The local oscillator uses a pair of bipolar transistors to produce about +15 to +17 dBm of signal, which is combined in the TUF-1H mixer with the 28 MHz IF. (This is considered a high-level mixing scheme).

From here, the combined 144 MHz signal is then amplified by a MAR-6 MMIC which drives an MRF 559, producing about 50 to 70 milliwatts. This is in turn fed to a M57727 power module which produces between 20 and 30 watts output, depending on drive level. Filtering of spurious responses occurs in three places. First, a Toko 1153A 2-pole filter is used between the LO and mixer. A Toko 1119A 3-pole filter is employed after the mixer, and another two-pole 1159A is placed between the MRF 559 and power module. The result? Down East claims spurious down better than -65 dB.

On receive, the incoming signal is fed to a Hewlett-Packard ATF13484 GaAsFET which offers plenty of gain with a very low noise figure but high dynamic range. This is then amplified by a MAV-11 MMIC and fed back through the same TUF-1H mixer. The resultant 28 MHz signal is fed directly to the 10 meter radio, although another optional gain stage can be added to increase the conversion gain by roughly 10 dB. If you are using an older HF transceiver with reduced front-end performance, you'll probably want to add this extra stage.

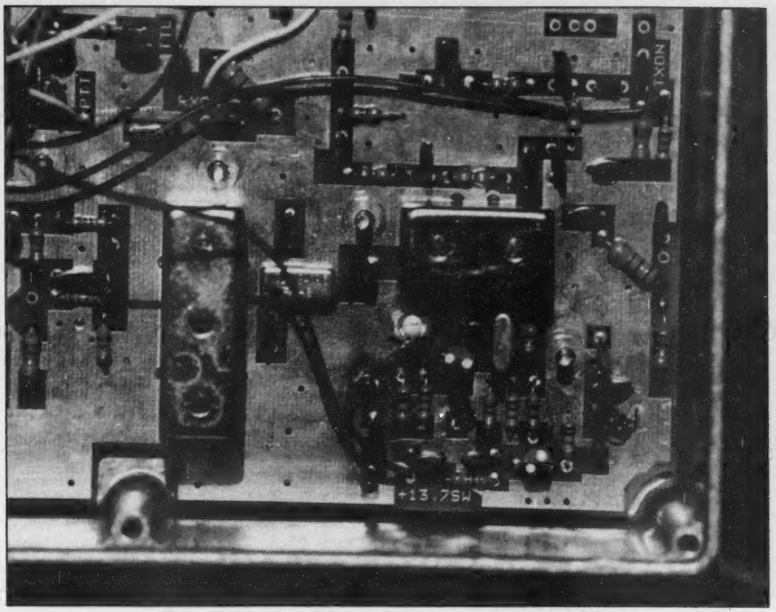

Photo C. Local oscillator and filter stages on the 222-28K.

The 222-28K doesn't differ much from the 144-28K, with a few exceptions. The LO runs at 97 MHz instead of 116, and another MMIC stage is used as a frequency doubler stage to get to 194 MHz before the mixer. (See Photo C.) The same filter arrangement is used, but Toko 1164A, 1145A and 1166A two- and three-pole models are substituted. The power module is a Mitsubishi M67712, which in my finished unit made about 18 to 20 watts output. The HP ATF13484 GaAsFET

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is also used ahead of a MAV-11 MMIC stage, and the same optional MMIC stages are available for low-level 28 MHz drive and additional conversion gain.

Construction

I spent part of a vacation week assembling the 144 and 222 MHz models. For an experienced builder, one weekend of casual "catch time as you can" is more than enough to build either box and align them, but if you're determined, you can crank both boxes out in one day. Start by laying out sheets of white paper or posterboard to keep track of all the small parts, such as resistors, disc capacitors, semiconductors and hardware. All chip resistors and capacitors are taped to a white index card and clearly identified.

For tools, you won't need more than a soldering iron, diagonal cutters, needle-nose pliers and two drill bits: 3/32" and 3/16". Down East provides more than enough enameled wire for the six coils you'll need to wind for each kit, and the balance of the coils are sealed inductors. The instructions provided are a bit on the skimpy side, although a detailed board layout and parts placement diagram are included along with a schematic.

The Toko filters are prealigned and require no adjustment once they're installed, so resist the temptation to do any "tweaking" unless you have access to a network or spectrum analyzer. My suggestion is to populate the circuit boards with all resistors, coils and disc capacitors first, then install the filters and small chip components. The MMICs and GaAsFET can be installed last.

Another suggestion would be to install everything including the two relays, but leave the power module out to allow bench testing before final assembly. The reason for this was a problem I had with the supplied OMRON B5Y-1 50 ohm relay on the 222-28K: It didn't work at all. A call to Down East brought a quick replacement, whereupon I was able to verify power output from the MRF559 stage.

Depending on your 28 MHz source, you'll probably want to install the optional 28 MHz RX booster stage. My IF radio is the time-tested Kenwood TS-430S, which was never known for having a terribly hot front end so it benefited from the extra boost. I didn't need the optional 28 MHz TX booster stage as the TS430S has over 10 mW of drive available. On the 222 MHz unit, I was not satisfied with the overall system conversion gain, so I substituted an Avantek ATF10135 in the front end with noticeable improvement. (Apparently there have been changes made to the Toko filter tunings since I bought my kits and later versions have more gain all through the system.)

Alignment is fairly simple, but you should use a 50 ohm dummy load and wattmeter to verify power module performance. Power output should be evident with as little as -12 dBm of drive, assuming you haven't installed the optional TX booster. If you have access to a calibrated signal generator or on-air beacon, you can tweak the two trimmer capacitors on the RX input for maximum gain and be fairly close to the optimum noise figure, under 0.5 dB.

Performance

Both boxes displayed excellent numbers on the test bench, which consisted of a Hewlett-Packard 608F signal generator and a Boonton 92 RF millivoltmeter. The HP608F did double-duty as a calibrated RF source at 144 and 222 MHz for receive tests, and as the IF exciter at 28 MHz. An ICOM IC-751A served as the receiver for weak signal tests.

The 144-28K exhibited very linear performance over a wide range of transmit and receive signals. At -30 dBm of 144 MHz input, I determined the system conversion gain to be about 28 dB. (I usually like to see an "S9" signal on my HF radio with 1 uV of signal at the VHF frequency.) I was able to increase the 2 meter input signal to the transverter to -25 dBm (11 millivolts) before I saw 1 dB of compression, which is an excellent figure. The 144-28K would appear to have what it takes to stand up in high RF fields, such as during a contest. Less than 0.15 µV was needed to produce 10 dB S/N.

On transmit, I saw 1 watt of output at -12 dBm. Cranking the HP608F up to 0 dBm (1 milliwatt) produced 10 watts of output across 50 ohms, as measured with a Bird 43 and 25C slug. An increase to +3 dBm (2 milliwatts) saw a corresponding increase to 20 watts output. The power output begins to level off after this point as either the mixer or following stages saturate. My maximum output was 25 watts at +7 dBm, the upper limit of the 608F. LO leakthrough at 116 MHz was measured at -21 dBm, over 60 dB below the carrier.

The 222-28K also exhibited very linear performance, if not slightly better than the 144-28K on receive. This was probably due to the substitution of the GaAsFET from the HP model to the Avantek ATF10135. System conversion gain with the optional RX boost was measured at 29 dB, and I was able to crank a signal of 19 dBm (25 mV) into the transverter before it went into compression, another tough performer for contest work. Again, less than 0.15 µV produced 10 dB S/N.

On transmit, the 222-28K is a bit more sensitive than its 2 meter brother, producing 1 watt of output at -18 dBm drive. Increasing this to 0 dBm resulted in 12 watts, however, as the system went into saturation. Increasing drive further to +3 dBm resulted in 17 watts output. I understand that the changes made to the Toko filter tuning by N2CEI is now resulting in over 25 watts output from the M67712 power module. LO leakthrough at 194 MHz was measured at -21 dBm.

On the Air

I was able to put a few hours on the air during the ARRL September VHF QSO Party, using the 144-28K with a 19-element yagi and 200 watts and the 222-28K with a 13-element yagi and 120 watts. Some enhancement was observed during the contest, but for the most part I made contacts under normal conditions, working into Canada (FN25), the Virginia shore (FM27), West Virginia (FM08) and western Pennsylvania (FN00).

In each case, I tried the transverters with my amplifier's built-in GaAsFET preamps, and opted to leave them off as both front ends are quite sensitive. The filter options on the TS430S took care nicely of some strong adjacent signals that gave my older MMT boxes fits! It took a lot of signal from a nearby 1 KW station with my beam right on him before I noticed significant crunching and IMD products.

Conclusions

Both the DEM 144-28K and 222-28K represent a big step forward in transverter design for both veteran and new VHF/UHF weak signal operators. With the wide range of TX and RX options, any model HF transceiver on the market should work fine with either box. Their output is tailored to the current line of brick amplifiers from RF Concepts, TE Systems and Mirage, but you probably won't need the internal preamp as the ATF GaAsFETs are more than up to the job.

Two minor complaints: First, the instructions could be a bit more detailed. I've built plenty of kits over the years but can make mistakes just as well as anyone else! Also, the parts placement diagram would benefit from a tinted overlay to show circuit traces in relation to solder holes—there's a couple of places where it would be easy to insert a component into the wrong holes, and plated-through holes are difficult to desolder. However, Bill Olsen of Down East Microwave has always provided me with solid technical and parts support, especially in the case of the defective relay. ■

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by Steve Katz WB2WIK/6

The Sentech Model Q144-8 2 Meter Quagi Antenna

Take another look at this VHF workhorse.

The Quagi is a beam-type antenna combining the advantages of a cubical quad and a yagi. Quagis were unheard of (although probably experimented with) prior to the publication of the first design and construction articles in *QST* (1977) by Dr. Wayne Overbeck N6NB, but have become very popular among weak-signal VHF-UHF enthusiasts. The term "Quagi" has become generic by virtue of their designs being published in the *ARRL Antenna Book* and elsewhere every year since the original articles appeared.

While multi-element, long-boom quads work fine at VHF, their additional windloading and complexity of construction makes their use cumbersome. Yagi-Uda beam antennas are simpler to build and install, consume less vertical space and offer reduced windloading, explaining their popularity with amateurs and commercial users since their invention. Overbeck, an avid VHF-UHF contester and early-years moonbouncer, did a great deal of groundwork back in the mid-1970s to determine that the primary advantage of the quad over the yagi could be achieved by the use of full-wavelength loop driven and reflector elements, and that substituting linear directors for the conventional loop director elements used in longer quad antennas sacrificed almost nothing in gain and other desirable characteristics. Thus, the "Quagi" was born, using quad loop driven and reflector elements on the same boom as straight linear director elements. The Quagi, by virtue of the full-wavelength loop driven element, begins life with some degree of gain over a conventional half-wave dipole and therefore has an advantage right from the start, even before adding parasitic elements to form its directional pattern and increase gain.

The loop driven element has gain over a half-wave dipole because it has twice the aperture, or cross-sectional area. In addition, the full-wave loop does not have its high-impedance (and thus high-voltage) points at the element tips like a half-wave dipole does, since there are no element tips at all. This allows use of the loop driven element in more severe environments, such as rain and snow, because the element is less prone to detuning from precipitation buildup at the element ends. Overbeck determined empirically that the advantage of the loop driven element could be enhanced by the use of a loop reflector, but conventional loop directors could be replaced by linear director elements with little degradation in performance; he also determined that for a given boom length, nearly any Quagi offers more forward gain than a conventional yagi possibly can. He published his design data only after personally using Quagis in successful contest, portable, moonbounce and other weak-signal operations, and the rest is history. No experienced weak-signal VHFer is unfamiliar with Quagis, and many are using home-brewed ones.

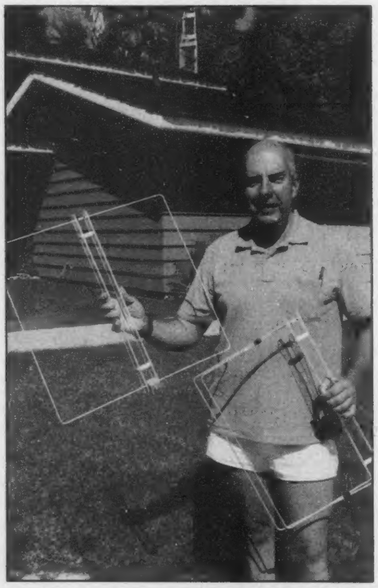

Photo A. The inventor of the Quagi, Wayne Overbeck N6NB, holding the assembled driven element and partly-assembled reflector element from the new Sentech Q144-8 Quagi. Wayne is beaming like a proud papa.

N6NB's original Quagi design calls for using a non-conductive boom (typically bamboo, wood, Fiberglas, or even Plexiglas for short-boom UHF arrays) and loop elements made of #12 vinyl-covered copper household electrical wire. While thousands of these have likely been built, most won't survive severe weather because of the lightweight materials used. (Wayne is a personal friend of mine, and I've seen him build a complete 2 meter, eight-element Quagi in less than 30 minutes, from scratch, at a total cost of maybe $10. The inexpensive, lightweight materials do have some advantages for those building lots of temporary antennas.) But now weak-signal enthusiasts have the option to purchase a much heavier-duty Quagi made of precut, machined materials, to yield a high-performance antenna at a reasonable price: Enter Sentech, Inc., of Riverview, Florida.

The New Option

Sentech, owned and operated by Lowell Malo WB0MGS, has been offering competitively-priced, high-quality Quagi antenna products for more than a year. I worked Lowell on 6 meters back in June during a coast-to-coast E-skip opening, and then called him on the telephone to discuss the Quagi product line. Then I bought one.

I showed the new antenna's parts to Wayne N6NB before assembly. He made some quick measurements on the quad loops and the director element lengths and concluded that Sentech had probably done their homework and adjusted his original design to accommodate the different materials used. Instead of insulated #12 copper wire (which can deform if a large bird nests on it!) for the loop elements, Sentech has used bare 3/16"-diameter solid aluminum. Sentech's materials are much stronger, but require adjustment of the loop dimensions because of the reduced wire inductance and increased velocity of propagation. N6NB's original design, optimized for 144.5 MHz, used an 86-5/8" loop for the reflector, and an 82" loop for the driven element; sure enough, Sentech has

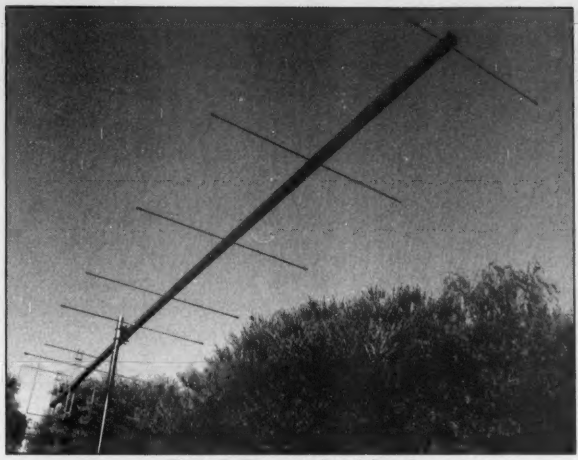

Photo B. The completed Quagi.

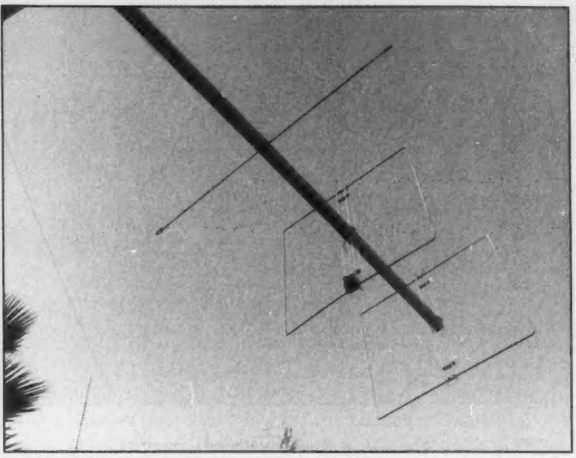

Photo C. The "business end" of the assembled Quagi, showing the reflector and driven element quad loops and their mounting arrangements. You can also see the first linear director element.

changed this, and uses an 88" loop (not quite square, but this isn't important) for the reflector and an 84" loop (also not quite square, with the same form factor as the reflector) for the driven element.

The original Quagi used an insulated boom and brazing rods for the director elements; Sentech uses a square aluminum boom (assembled from three sections) with 3/16" aluminum directors insulated from the boom by Delrin stepped washers, held in place by spring steel retainer clips. N6NB also used wooden "spreaders" to support the quad element loops and attach them to the boom, and the 2 meter Quagi used two such spreader "arms," one vertically and one horizontally. The Sentech version uses only vertical spreaders, but uses two side-by-side for each loop element, and the spreaders are made of thick Plexiglas. Despite the variation in materials used, Sentech hasn't notably changed Overbeck's original director lengths or spacing pattern. Both the original Quagi and the Sentech model use eight elements on a 14-foot boom. The main difference is that the Sentech is designed to last a long, long time, even in Florida hurricanes!

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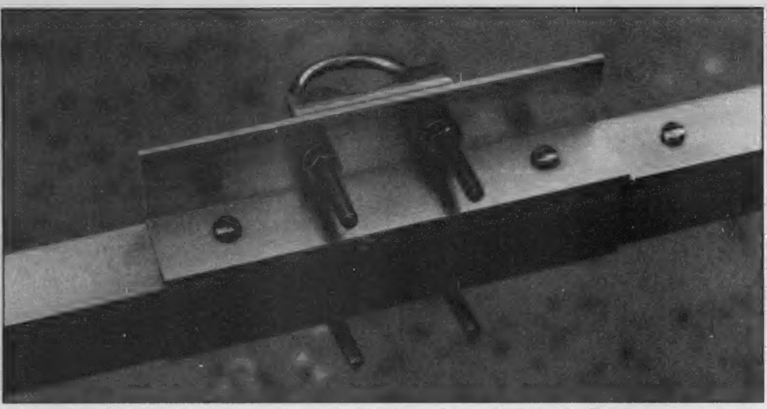

Photo D. Detail of the boom-to-mast bracket of the Sentech Q144-8. The brackets are aluminum stock, held in place by two stainless steel machine screws each. The screws are threaded into tapped holes in the boom.

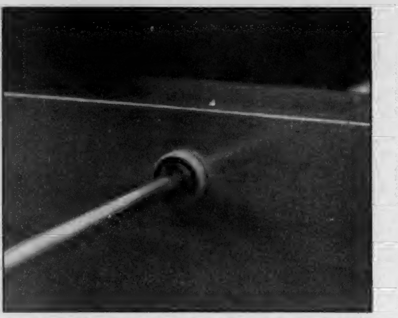

Photo E. Close-up detail of one of the director element attachments to the square boom. Two Delrin shoulder washers, firmly clamped in place by spring steel retainer washers, attach each of the directors.

Assembly

After shooting the requisite photographs of N6NB holding parts of the Sentech product (see Photo A), I took it all home and assembled it in my garage. The Quagi goes together in about 30 minutes and the piece parts are of very high quality. However, their assembly directions leave something to be desired. The directions state, "A letter is stamped on the boom on the adjacent sections," when in fact, no letters are stamped or imprinted anywhere. This might leave some neophytes scratching their heads about how to assemble the boom properly, although I figured it out. Then, while the directions are quite clear about how to install the director elements, there is no dimension chart anywhere to help one confirm if he is really putting it together correctly. The addition of a simple dimension chart, indicating all element lengths and spacing between elements, would be very helpful.

Then, the directions state, "All the spreader bars are the same overall dimensions," (true), and "The spreader bars for the driven element, however, have the mounting holes closer to one edge, while the spreader bars for the reflector are symmetrical," (untrue—there's no difference). Also, the quad loops each arrive in two pieces which must be assembled by the user. This requires a 5/64" Allen wrench, a 10-cent tool that many folks won't have laying around. It would have been prudent for Sentech to include one with the antenna. Also, the directions have a typo which states, "remember, the smaller ones are for the director," referring to the size of the quad loops. This isn't true: There are no director loops. They meant to say, "driven element."

The quad loop "spreaders," which support the loops and mount them to the boom, are attached with just one #10-24, 2" stainless-steel machine screw each. This allows the loop elements to "rock" back and forth, since a single-point mounting offers no resistance to angular changes. Sentech recommends, "Place a small amount of RTV (silicone caulking) on each side of the boom adjacent to the mounting hole. This will seal the hole and prevent the spreader bar from rotating." I did this, and it worked. But if a small amount of RTV is required for assembly, Sentech should supply a small tube of it with the antenna since, again, this is something many users won't have laying around. Better still, it would have been nice if Sentech used two machine screws to hold each spreader in place against the boom; then, it couldn't rotate at all and you wouldn't need the RTV.

The directions go on to say, "The optional antenna connector assembly . . . " (an SO239 UHF receptacle mounted in a small box at the feedpoint of the driven element loop), whereas the connector appears to be standard (my antenna came with one, and I didn't ask for it). The factory-supplied connector is a good idea, as it is difficult to solder to aluminum and most users would have no other way to connect their transmission lines. However, the factory-supplied connector attaches to the open ends of the driven element loop with small aluminum clamps screwed into a molded block assembly, and no matter how much I torqued down those screws, I couldn't make the connections tight. I had to take the aluminum clamps off the block, reform them to make them fit snugly around the 3/16" aluminum rod from which the loop is constructed, and try again. I finally got it reasonably tight. Since this is an aluminum-to-aluminum joint which will conduct a lot of RF current, it would be wise to add a coating of "Noalox" or "Oxguard," or some similar anti-oxidation compound, to these connections prior to assembly and tightening. The slightest amount of oxidation at these connection points will degrade performance, as aluminum oxide is not a good conductor. Again, I think Sentech should supply a small tube of such a compound with the antenna and recommend its application for all but temporary installations.

The Final Product

Despite the foregoing complaints, the antenna assembled well and yielded a professional, finished appearance. The materials are surely as good as those used in any commercially-manufactured VHF antenna I've ever seen, and are better than some. If Sentech would revise their instructions (see Note 1) and include the dimension chart, Allen wrench, RTV and anti-oxidation grease with the product (even if this raises the price a bit), I think users would be happier.

I did note that the factory-supplied-and-installed boom-to-mast bracket does not allow its movement along the boom, nor rotation to allow for vertical polarization of the Quagi. I guess the Sentech Quagi is designed for SSB-CW users only, since almost all FM work is vertically polarized. A shame, since the Quagi does lend itself well to FM use and will outperform many of the "FM yagis" sold (see Note 2). My objection to the stationary bracket is that, while the bracket is preinstalled in the proper position to balance the antenna when a simple RG8/U-type transmission line is attached, it would not be in the proper position to balance the antenna if a larger, heavier feedline were used. (RG17/U, for example, is pretty popular with weak-signal VHFers. It weighs about four times as much as RG8/U and has correspondingly

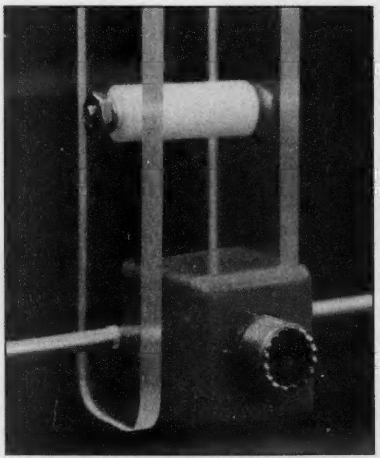

Photo F. Close-up detail of the SO239 feedpoint assembly of the Sentech Quagi driven element loop. The white ceramic spacer bolted between the two Plexiglas spreaders are also shown.

lower loss, and its use would unbalance this antenna.)

Operation

How does the assembled antenna work? Like an F16 among B29s! Lacking a professional antenna range to make accurate gain measurements, I can't offer any. But I can say that the Sentech Quagi dramatically outperforms the 2 meter yagi antenna I replaced on the same mast, using the same coax. The old "reference" antenna was a nine-element Tonna F9FT yagi (made in Reims, France) on a 12' boom. These are very popular in Europe; not so much here in the States. But years ago I compared the nine-element F9FT "Tonna" antenna to a popular brand-new 11-element, American-made yagi on the same boom length, and the French antenna outperformed the American product in every way: better forward gain, better front-to-back ratio, less pronounced sidelobes. So, I'll go out on a limb and say that the Sentech eight-element Quagi is clearly superior to any 12' yagi made by anybody. Of course, it should be: It's two feet longer, and has the advantage of that full-wave driven element and reflector.

My reference signals for making this comparison are local beacon stations, ranging from about 30 to 200 miles from my home station. I took daily data on their signal strengths for about one week prior to replacing the antenna. Now I've taken daily data on the same beacons for one week again. They range from 4 dB to 11 dB stronger, depending on which beacon I tune in, on the Quagi. This data is "normalized," and averaged over a period of one week to help dampen the variations in propagation. Not one single beacon station is weaker with the Quagi: They are all stronger, by varying amounts. And the Quagi is installed the same height above ground, on the same mast and rotator, and connected to the same coaxial feedline, as the old antenna was. Not the most scientific test in the world, but the best I could do.

The Q144's VSWR is excellent, dipping to less than 1.2:1 at 144.5 MHz, and rising to about 2:1 at 148 MHz. It is clearly optimized for the low end of the 2 meter band. Prospective FM users who modify the mast-mounting arrangement to accommodate vertical polarization might want to reduce the driven element and reflector loop lengths very slightly to favor the 146 MHz area.

In all, I'm very impressed. I've built perhaps a dozen Quagis over the years, and they all worked well—better than similarly-sized yagis of any brand—but none were robust enough to install permanently in a high-wind region. The Sentech appears to work as well as my home-brew, bamboo-boom versions, but is far more rugged, and I don't anticipate any problems with it for years to come (see Note 3). Sentech also makes Quagis for 222 and 432 MHz, and they are likely to be fine products as well. I'm thinking of buying the higher-frequency versions myself.

The last obvious question is: Will the eight-element Quagi outperform a 13-, 14- or 15-element yagi? The answer depends on the boom length and design of the yagi in question. Many yagis are built on booms too short to take advantage of the quantity of directors used. In these cases, the element count can often be reduced without impacting performance. (More elements must sound better in the advertisements, I guess.) It has been my observation that the eight-element Quagi seems to perform about equally to a well-designed yagi having a 16- to 21-foot boom length (for 144 MHz), regardless of the number of elements used. Considering that the Quagi is only 14 feet long, that's not bad. ■

> ***"The Sentech appears to work as well as my home-brew, bamboo-boom versions, but is far more rugged, and I don't anticipate any problems with it for years to come."***

Notes:

1. After reading a preliminary copy of this article, Sentech agreed to make changes in their assembly instructions. I have since received the revised instructions and they are much improved.

2. Sentech does offer an "FM" version of the Quagi, set up for vertical polarization and tuned for the FM subband. They are also considering design changes to allow easy polarization changes in the field, by the user.

3. N6NB stated that, in his opinion, the use of Plexiglas spreaders for the loop elements is unwise as all forms of Plexiglas, even those which contain "UV blockers" or "UV stabilizers," deteriorate with age and ultraviolet radiation from the sun. Plexiglass also does not hold up well in freezing/thawing cycles, such as when covered with ice which melts and then reforms. I discussed this at length with Sentech and determined that they use genuine Plexiglas, made by Rohm & Haas (Bristol, PA). The manufacturer has supplied us with sufficient data to allay any fears I might have had about the operating life of their material in the weather, including strong, direct sunlight. Sentech advised that they looked a long time for a more resiliant substitute for Plexiglas but couldn't find one. Time will tell if the Plexiglas used will survive prolonged exposure, but even if it is only as good as the other plastic insulating materials used in competitive amateur antenna products, it should last several years.

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73 Review

Number 11 on your Feedback card

by Don Johnson K7UGQ

Radio Shack/Tandy Corporation
500 One Tandy Center
Fort Worth, TX 76102
Catalog No.: 21-543
Price Class: $80

Radio Shack's DSP-40

A low-cost Digital Signal Processor you can add on.

When my wife visits our local mall's book emporium, it has become an unspoken "OK" for me to stop in to check out the new goodies at Radio Shack. I guess you could say they know me. Like a "regular" visiting the local watering hole, I'm usually greeted not only by the proprietor but also by some of the patrons! During my visits, I'm always on the lookout for new communication gadgets, especially those that may have applications in ham radio. The latest visit didn't disappoint me, as the manager was in the process of placing a "New Item" sticker on a small black plastic box in the display case. A closer look revealed a Digital Signal Processor, or DSP-40 noise reduction device.

Since moving to New England I've discovered that noise on the ham bands and shortwave broadcast bands can ruin an otherwise fun hobby. Thunderstorm static all but eliminates any communication activity until after the storm is long gone. In addition, my local power company, in spite of their denial, has several leaky power insulators in my neighborhood that generate some real havoc when they get wet. So, out came the plastic money and home went the DSP-40 unit for a test.

Housed in a plastic case, the DSP-40 measures approximately 2" x 5.5" x 7". The almost 1.5 pound unit contains the electronic noise reduction circuits, an audio amp, built-in speaker, and associated switches, indicators and a volume control.

Digital Signal Processing, unlike passive inductors and capacitor filters, uses computer technology to digitize analog audio output. Once digital, it's fairly easy to identify the noise culprit and filter, clip, or otherwise eliminate any fractional portion of the signal, and reassemble the signal back to analog for playing through speakers, sans the noise. Several manufacturers of high-quality receivers and transceivers are currently including or offering as an option DSPs with their top-line radios. While low- and middle-line radios rely on less effective passive notch filtering and bandpass filters to help reduce received noise.

The Radio Shack DSP-40 is an audio (not intermediate frequency) device that offers selectable low-pass noise reduction filters. What this means is when plugged into the earphone or audio out jack of a receiver, not only does the received noise disappear but also those annoying heterodynes from adjacent ham and foreign broadcast stations. In addition, three levels of CW and SSB bandpass filtering can be switched in from front panel switches.

Mode	Selectivity	
CW	Wide	1000 Hz
	Med.	500 Hz
	Nar.	300 Hz
SSB	Wide	2700 Hz
Med.	2100 Hz	
Nar.	1200 Hz	
NR (noise reduction)		2700 Hz

To compensate for reduced volume levels as a result of inserting the various filters, a 6 watt amplifier is included.

I immediately attached the speaker-out cable from my IC-735 transceiver to the input jack on the rear apron of the DSP-40, connected the power and turned the unit on. My enthusiasm was quickly suppressed when all I could hear was severely distorted audio. Regardless of what switch was toggled, everything was a blur to my ears. Should things not go as expected, shut everything down and begin reading the 10 printed pages of the manual. I soon discovered that I was overdriving the DSP-40 with the volume control on the transceiver. A quick retest verified that you must not exceed the input level threshold or distortion will occur. This limitation proved to be an impediment some may not be able to live with. More on that later.

Further testing with the IC-735 produced only subtle results. The excellent notch filter and bandpass filter on the IC-735 was able to accomplish much the same thing the DSP-40 was providing. Later that evening, I discovered the value of the DSP-40's ability to eliminate 80 meter heterodynes. Maybe now I can hear all of the local swap net without adjacent frequency jamming! Next, I connected the DSP-40 to an older transceiver, a Drake TR-4. Voilà! The DSP-40 worked beyond my expectations. Heterodynes and the familiar "rushing" noise found on 80 meters could be virtually eliminated without any noticeable loss of received signal. Now, this is what I wanted and was anticipating. After all, the manual did state that heterodyne rejection is 40 dB. When using earphones while copying code in the crowded 80 meter Novice portion of the band the unit did even better. Static burst, however, could not be eliminated, or for that matter reduced, by any appreciable amount.

Radio Shack
DSP NOISE REDUCTION SYSTEM
BANDWIDTH
NARROW MED WIDE
FILTER
NR SSB CW
POWER
OFF
DSP DIGITAL SIGNAL PROCESSOR
VOLUME
DSP

Pleased with its performance with heterodynes on an older transceiver, I installed the DSP-40 in the family car. After all, it comes with a mobile bracket and mobile power adapter. Armed with the IC-735, a 2 meter FM transceiver and a standard AM CB transceiver, I began a four-hour trip to upstate New York. This time I met with real failure. The sensitive audio drive requirements prevented me from developing enough volume to hear anything but the strongest of signals. I attached a speaker specially designed for mobile use, with the result again being low volume. The only way I was able to obtain sufficient audio level was to close all windows, thus eliminating the wind rush noise. This may not be acceptable to those without air conditioning.

Well, with windows rolled up, I attempted to contact several hams on the HF rig. No way! It seems that when I operated on 40 meters (7 MHz), RF feedback caused the DSP-40 to emit an excruciating scream, instant oscillation. Since this was not a problem with the station in my shack, my mobile installation may be suspect. Next I tried the 2 meter rig. No oscillation; however, an annoying low level hum was evident while transmitting. The CB rig didn't present any problems.

Does the DSP-40 work? Yes, with some reservations. If you plan to use earphones with the DSP-40 attached to older receivers/transceivers (those with fixed selectivity), and at a well-grounded base station, I'd say it works very well. I installed a double-pole, single-throw switch to completely bypass the DSP-40 when its service is not desired. This eliminates the internal amplifier completely, giving me normal sounding audio. When needed, I flip the switch. When compared to other digital processing units currently on the market, the DSP-40 offers a reasonably-priced solution to an annoying problem.

Radio Shack should consider incorporating some RF bypassing, and better audio recovery circuits. Note: I tried some random capacitors in the audio output line and was able to reduce (but not elimiate) the RF feedback problem. However, placing four ferrite chokes on each audio and power line did not seem to offer any help.

During a recent telephone conversation with Radio Shack engineers in Ft. Worth, Texas, the feedback problem was discussed. It appears that feedback similar to what I experienced may not be unique to the DSP-40. Further testing revealed that separating the DSP-40 and my IC-735 six to eight inches eliminated the squealing. Further experimentation revealed that when the DSP-40 was mounted directly on top of the transceiver and directly over the RF section, the feedback could be made to disappear.

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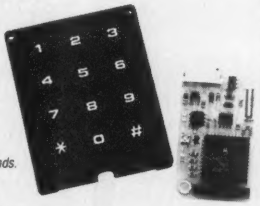

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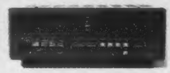

Solid state design with a built in antenna tuner makes for a no fuss QSO in tough conditions. This amplifier provides a full 1200 input and allows manual tuning if desired. It's time to try this competitor.

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Satellite and all-mode 2m/70cm work gets exciting with this full-feature transceiver. Linked tuning, 12 unlink memories, 100 memories, and 2 optional modules offers band extensions for 6m, 220MHz, or 1.2 GHz operation.

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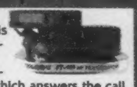
FT-900/AT



The FT-900/AT is a revolutionary HF transceiver which answers the call for a truly practical mobile radio. Its unique remote-head construction allows installation where no other transceiver can be mounted. 100 watts, 100 memories, dual VFO's, IF Notch and many more features.

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FRG-100B

This new high performance table top receiver provides general coverage from 50 KHz - 30 MHz in all and FM at an affordable price. Features include 50 memories, noise blanker, 10 MHz, 100 and 1 KHz tuning steps, selectable attenuation, twin clocks and scan mode.

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FT-990

The new FT-990 combines the basic technical features of that top-of-the-line model with several new advances in both transmitter and receiver circuitry. Digital filter, 90 memories, wide dynamic range and much more!

- FT-990DC $1819 95

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FT-690R/II

Portable or mobile, this 6 meter all-mode transceiver delivers fun and function. The 10 watt linear amplifier clips on in place of an optional battery case to extend your operating horizon.

- FT-290 2m Txcr $579 95
- FT-790 70cm Txcr $679 95

$689 95

FT-290R/II

Portable or mobile, this 2 meter all-mode transceiver delivers fun and function. The 25 watt linear amplifier clips on in place of an optional battery case to extend your operating horizon.

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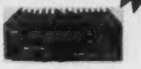

This new 2 meter mobile borrows its ruggedness from the FT-2400H while adding great new features such as advance track tuning, time out timer, A.P.O., 9600 bps option, 31 memories, the new "omni-glow" LCD display and more!

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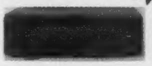

This compact, full-featured mobile comes with 49 memories, 10 DTMF auto dial memories, A.R.S., CTCSS encode, digital squelch and lighted keypad are standard features.

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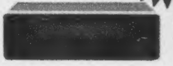

The removable front panel lets this dual bander fit any installation. It features 50w out on 2 meters, 35w out on 70 centimeters, 32 memories, CTCSS encode and PAGE mode.

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FT-5100

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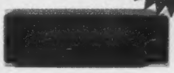

This dual band mobile features 100 memories, cross band repeat, lighted keypad, built-in duplexer and a small footprint. Dual watch capability rounds out this 50/35 watt VHF/UHF transceiver. Packet ready.

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FT-11R

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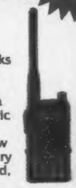

This new HT packs the features you want in a small size. It features a new alphanumeric display, super small profile, new square "D" battery design, lit keypad, AM air craft receive, DSQ & CTCSS encode.

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Cheap Dual-Band Yagi

A fine VHF/UHF beam made from old TV antennas.

by Marty Gammel KA0NAN

Last summer I was looking for a dual-band (2 meters and 70 cm) yagi antenna. I looked at the commercial designs available and felt that they had too many design compromises. The commercially-made antenna was a five-element 2 meter yagi with a gamma match, mounted on one side of the boom, and a five-element yagi for 70 cm on the other. I felt that there was too much interaction between the elements of the two antennas, because they were side by side on the same boom.

The design I decided to make was a five-element 2 meter yagi, having about 9 dB of gain, with a six-element 70 cm yagi directly in front of it on the same boom. The six-element yagi would have about 10 dB gain, and both should have excellent front-to-back ratios. For the 2 meter beam, I used a design I had published in the December 1993 issue of *73 Amateur Radio Today*. I am very happy with the excellent performance of that design, and will explain just how to combine the VHF beam and UHF beams, one in front of the other. For the 70 cm version I readjusted the director spacings, and added another director to give some extra gain. I like using a "T" match balanced feed system rather than a gamma match. The gamma match system can skew the pattern of an antenna, while the "T" type balanced feed system gives a straight, more symmetrical pattern of radiation.

People give me their old TV antennas and I strip off all of the pieces of aluminum tubing that are usable. These I save for future projects. (Only the short or bent pieces of tubing and the plastic parts are not reused.) This project uses a square boom that is 80" long. If you have a longer one, you can cut it down to size.

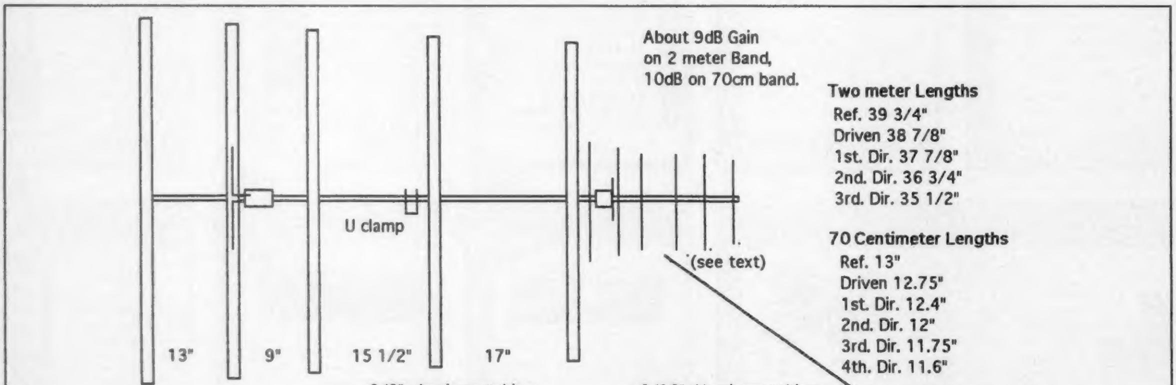
Our friendly local Amateur Radio Consignment Center was my source for the 3/16" aluminum tubing. Only $2 for a 12-foot long piece (such a deal!). Almost enough to make two UHF beams. I chose to use BNC chassis mount connectors on this project; you may want to use SO-239 or N-type connectors instead. I used two different styles of panel mount BNCs in this project. Use the type you prefer. My neighborhood hardware store had a good supply of 3/16" pushnuts, just the thing for attaching the UHF elements to the boom.

Radio Shack is my source for the plastic boxes needed to hold the balun assemblies.

With some good luck scrounging, this dual-band VHF and UHF antenna can be made for about $10. You may want to purchase a duplexer for about $30, to allow you to run a single feedline to your dual-band radio. (More on this later.)

I referred to the *ARRL Antenna Book*, 15th edition, for the proper way to make the balun. They are easier to make than you think. Due to our harsh winters, I needed to enclose the baluns, and I also needed good solid mounts for the "T" match feedpoints. I chose plastic project boxes from Radio Shack. The box that measures 2-1/2" by 4-3/4" by 1-1/16" (Radio Shack project box #270-222, $2.59) will house the balun for the 2 meter portion of the antenna.

For the 70 cm balun, I chose the Radio Shack project box # 270-220 that measured 2" by 4" by 1", for $1.99. The beam itself was easy, using an 80"-long square boom from an old TV antenna as a starting point. On the 2 meter portion of the antenna, I used 3/8" diameter aluminum tubing for the elements and "T" match bars. To further im-


About 9dB Gain
on 2 meter Band,
10dB on 70cm band.
Two meter Lengths
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Driven 38 7/8"
1st. Dir. 37 7/8"
2nd. Dir. 36 3/4"
3rd. Dir. 35 1/2"
70 Centimeter Lengths
Ref. 13"
Driven 12.75"
1st. Dir. 12.4"
2nd. Dir. 12"
3rd. Dir. 11.75"
4th. Dir. 11.6"
70 Centimeter Spacings
Ref. to Driven 4.25"
Driven to 1st. Dir. 3"
1st. Dir. to 2nd. Dir. 5.12"
2nd Dir. to 3rd. Dir. 5.12"
3rd. Dir. to 4th. Dir. 5.5"
U clamp
(see text)
13"
9"
15 1/2"
17"
3/8" aluminum tubing
used on 2 Meter antenna
3/16" Aluminum tubing
used on 70CM Antenna
Dual Band 5 by 6 Beam With Balanced Feed System
Balun feed used on 2 Meter Beam, and on 70CM Beam.
Baluns made from RG-59U coax. 1/2 wave, and1/4 wave
sections for each band (see text).

Figure 1. The Dual-Band Yagi has an 80" boom length.

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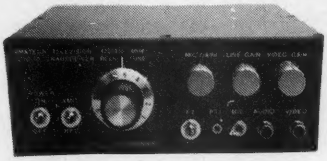

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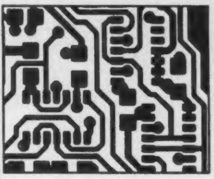

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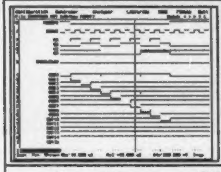

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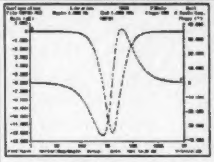

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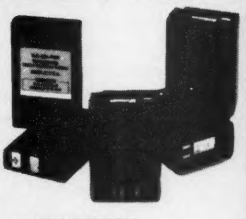

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**FNB-26-S	7.2v @	1500 MAH
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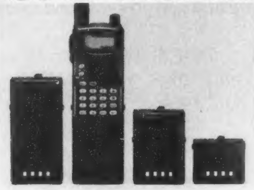

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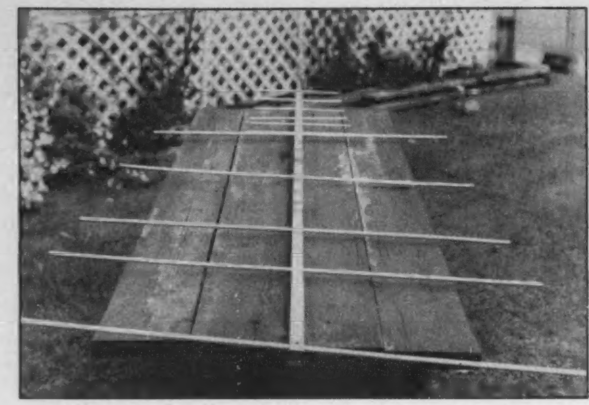

Photo A. Overall view before installing baluns and U-clamps.

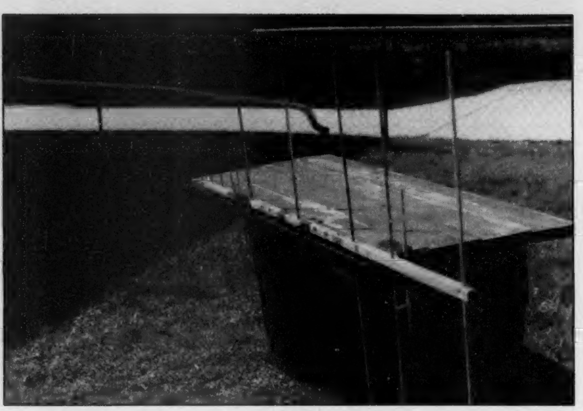

Photo B. Overall view showing baluns installed on opposite sides of the boom, ready for tuning.

prove the design features of this antenna, also from the *ARRL Antenna Book*, I added a ferrite bead choke on the quarter-wave RG-59U line section of the balun. The local electronic surplus house proved to be a cheap source of ferrite beads. I also wound the half-wave RG59-U section of coax into a four-turn choke to fit into the plastic box on the 2 meter section of this dual-band antenna. The combination of the ferrite beads and the four-turn choke provide feedline isolation, and avoid radiation from the feedline shield. The dimensions for the "T" bars came from standard design lengths for gamma match parts.

On the 70 cm section of the antenna, I again made up a half-wave section of RG-59U coax, and also a quarter-wave section of RG-59U coax to form the balun, using more ferrite beads on the quarter-wave section.

Assembly

See the Parts List. Once you have all the needed pieces, you can begin to build the beam.

Once all the old elements have been removed from the boom, mark where you need to drill to mount the five VHF elements. I found that by mounting the elements in the upper third of the boom (about 1/4" in from edge) the spacing for the "T" bar straps was more manageable; all the elements' centerpoints line up, and the beam will look better. I scribed a line along the length of the boom to mark the centerline for drilling the element mounting holes. If you can use a drill press to drill the element holes, they will be square to the boom. After the holes are drilled, try fitting the 3/8" tubing in each VHF element hole, and the 3/16" UHF elements in their holes. Check for squareness to the boom with a square.

The spacing for the elements, center-to-center on the 2 meter portion of the antenna, are: reflector to driven element, 13"; driven element to first director, 9": first director to second director, 15-1/2"; second director to third director, 17". On the 70 cm portion, after a 1" space from the 2 meter antenna, the reflector to driven element spacing, center to center, is 4-1/4"; the driven element to first director, 3"; first director to second director, 5-1/8"; second director to third director, 5-1/8; third director to fourth director, 5-1/2".

Cut all the elements to length and flatten one end of each of the two 6-1/2" match bars. Flattening about 1/2" will do (see photo/drawing). Drill a 1/8" hole in the flattened area, and round off the corners (see Figure 2). Attach all five elements to the boom using the 1" stainless steel screws.

Now drill the holes for mounting the BNC-type panel mount and the 1" #8 bolts in the plastic box, and attach the mount with three of the four bolts. (The fourth bolt will attach the coax shield of the quarter-wave section on the balun later on in the construction of the antenna.)

For UHF make the 3/16" match bars 3" long, flattening about 3/8" on one end of each bar. Use a 5/64" drill bit to drill the holes for mounting the bolts on the UHF balun box, and for drilling through the match bars.

Making the Choke and Balun Assembly

Start with the 2 meter balun first, using a piece of RG-59U about 14" long for the quarter-wave section, and prepare both ends as shown in the drawing. Do the same to a 26-1/2" piece for the half-wave balun section. Allow 3/4" on each end of both coax sections for dressing the ends for use. Wind the longer section of coax into a four-turn coil. Tape the coil temporarily in a couple of places, just to hold it until the finished balun

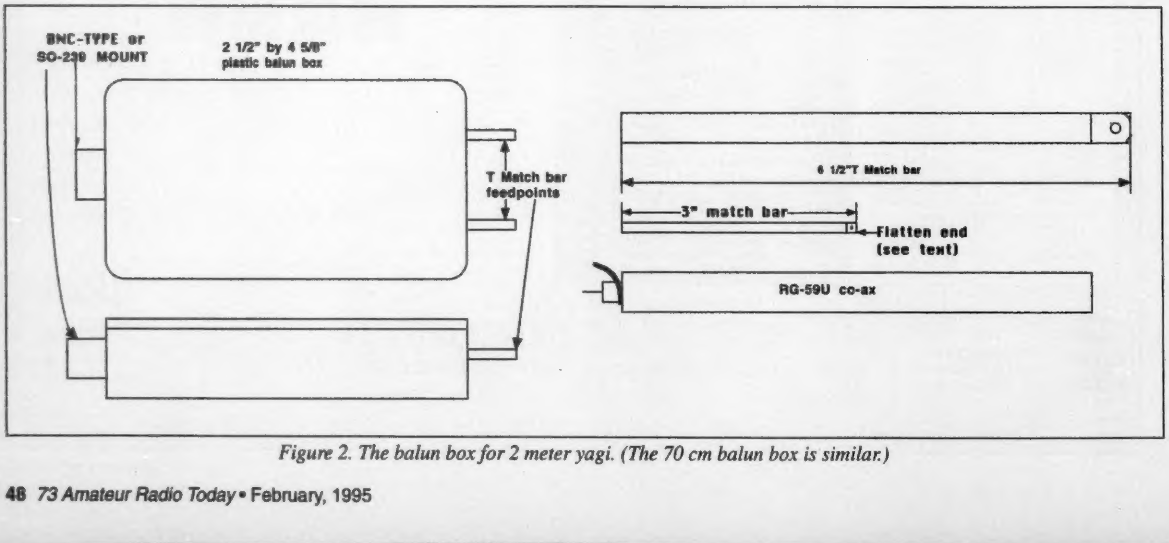

Figure 2. The balun box for 2 meter yagi. (The 70 cm balun box is similar.)

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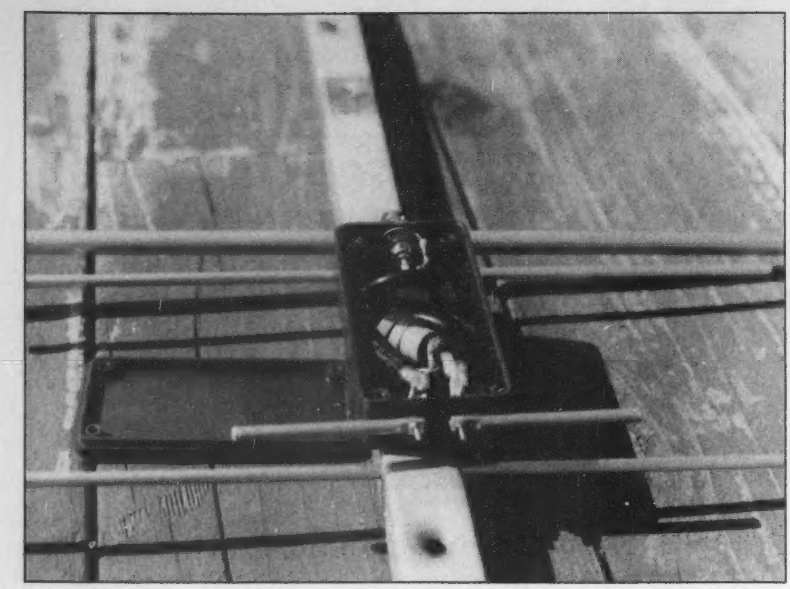

Photo C. Placement of 70 cm balun on boom.

is installed in the larger plastic project box #270-222. Solder the shields from both sections of coax together. Install the balun assembly in the balun box. Be certain that all connections are correct. On the VHF balun, install the closed-end crimp-type connector on each end of the center conductor of the half-wave coax. Install the 1" #8 bolts through the crimped connectors using washers, and apply a washer and nut to the outside of the plastic box. After doing this, remove the tape from the coil. Install as many ferrite beads as you have room for on the end of the quarter-wave coax section (I had room for six ferrite beads). Solder a closed-end crimp-type connector to the shield and then connect it to the fourth mounting bolt for the BNC-type panel mount fittings. Solder the center conductor to the center terminal of the BNC. Apply Crystal-cote or some other type of sealer to everything in the balun box.

To make the UHF balun assembly, cut an 8" section of RG-59U coax for the half-wave section, and form it into a loop that will fit in the smaller #270-220 project box. Cut a 4" section of RG-59U coax for the quarter-wave section. Solder the shields from the half-wave section and one end of the quarter-wave section together. Put the remaining four ferrite beads on the other end of the quarter-wave section of RG-59U coax.

The Mystical, Magical "T" Match Bars

Attach the "T" match bars to the balun boxes. Cut and form 3/8" wide straps around the driven elements and match bars. You will need two pieces about 4-1/2" long for the VHF straps, and two pieces about 2-1/2" long for the UHF straps. Then drill holes to bolt the straps to the tubing. You will need about 1-3/8" between the "T" bars and the driven element on the VHF section. Spacing for the strap should be about 4" from the center of each 1" #8 stainless steel bolt on the balun box. On the UHF section you will need about 5/8" spacing between the driven element and the "T" bars; the straps should be about 1" from the end of the match bars. Drill a weep hole in the lowest corner of the balun boxes for drainage once the boxes have been mounted on the boom. At this point add a ground wire from the BNC-type connectors to the boom.

Check all connections, nuts, bolts, and screws and then mount the antenna on a *non-conducting mast*, ready for tuning. Most antenna companies neglect to tell you that a metal mast is seen by the antenna as an out-of-place element that will detune the antenna. Tape the coax to the boom and bring the coax down the mast, away from the antenna.

Tuning the Completed Antenna

Tuning the antenna is easy. Do the 2 meter section first, then the 70 cm section. Connect a coax, SWR meter, and your radio to the antenna. Check the SWR at the top, center, and bottom of the frequency area of design. By noting the pattern of the SWR curve, you will know whether to move the match bars in or out for the best match. Move them only about 1/8" at a time, rechecking the SWR curve as you go.

Mine was very close to the center of the designed-for frequency, and only had to be adjusted about 1/8" from the text. Be sure to make all the adjustments of the straps on the "T" bars equal.

Dual Feedlines or Single-Feedline

Now is the time to decide whether or not to use a duplexer and phasing lines cut to half-wave multiples, or a single feedline. If you have a dual-band rig with one connection for a single feedline, and no internal duplexer, a duplexer system is necessary. I have single-band rigs and plenty of hardline, so for me dual feedlines were not a problem. To make up dual-phased lines to go to a duplexer, find the velocity factor of your coax, and use a half-wave for 2 meters and three half-waves for 70 cm. Attach the duplexer at this point. You will still want to do your preliminary tuning of the antennas separately, then with the duplexer installed, with its phasing lines installed as a final check.

Builder's Notes

If you are going to use the single feedline system, and your duplexer is built-in on your radio already, you may try using a "T" fitting to join the feedlines at the antenna (see text). Except for buying the ferrite beads and the plastic boxes to make clean, neat weatherproof feedpoints, all the 3/8" aluminum came from my stockpile of old TV antenna parts, and the 3/16" aluminum tubing came from our friendly local Amateur Radio Consignment Center. All the hardware is common, and can be bought from any local hardware or building supply store.

I cut all the aluminum to length with a common plumber's tubing cutter. It gives a more finished end than if you cut it with a hacksaw. Each VHF element is installed through the boom, and fastened with a 1" #8 stainless steel screw. Be careful not to over-tighten these screws because you may bend the element.

Mark the UHF elements for the depth needed to attach the 3/16" pushnuts. I used a piece of the 3/8" tubing to push the pushnuts onto the elements. If you cannot find an old TV boom, most local scrap metal dealers will sell aluminum square and round tubing.

When you are cutting the coax be careful to measure the lengths, and to check the velocity factor for the coax you use. My

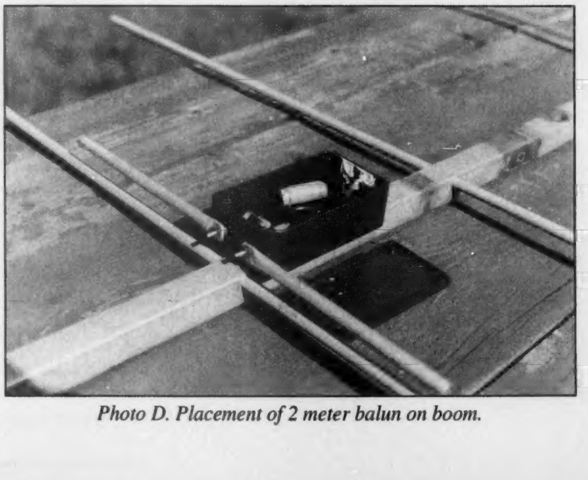

Photo D. Placement of 2 meter balun on boom.

Parts List

	80"-long 1"-square aluminum boom (old TV antenna type)	
	2-1/2" x 4-3/4" x 1-1/16" plastic project box	Radio Shack #270-222, $2.59
	2" x 4" x 1" plastic project box	Radio Shack #270-220, 1.99
	Piece of scrap sheet aluminum, brass, or copper (for match bar straps)	
10	Ferrite beads (to make the ferrite chokes) (see text)	
	12.5" section of RG-59U coax (finished length) (see text) VHF	
	25" section of RG-59U coax (finished length) (see text) VHF	
	8" section of RG-59U coax (finished length) (see text) UHF	
	4" section of RG-59U coax (finished length) (see text) UHF	
2 pieces	3/8" x 6-1/2" aluminum tubing (VHF "T" match bars)	
1 piece	3/8" x 39-3/4" aluminum tubing (VHF reflector element)	
1 piece	3/8" x 38-7/8" aluminum tubing (VHF driven element)	
1 piece	3/8" x 37-7/8" aluminum tubing (VHF first director)	
1 piece	3/8" x 36-3/4" aluminum tubing (VHF second director)	
1 piece	3/8" x 35-1/2" aluminum tubing (VHF third director)	
2 pieces	3/16" x 3" aluminum tubing (UHF "T" match bars)	
1 piece	3/16" x 13" aluminum tubing (UHF reflector element)	
1 piece	3/16" x 12-3/4" aluminum tubing (UHF driven element)	
1 piece	3/16" x 12-3/8" aluminum tubing (UHF 1st director)	
1 piece	3/16" x 12" aluminum tubing (UHF 2nd director)	
1 piece	3/16" x 11-3/4" aluminum tubing (UHF 3rd director)	
1 piece	3/16" by 11-5/8" aluminum tubing (UHF 4th director)	
2	#8 by 1" flat head bolts for attaching "T" match bars to VHF balun box	
5	#8 by 1" flat head self tapping stainless steel screws (for VHF elements)	
4	#8 by 1" flat head self-tapping stainless steel screws (for balun mounting)	
4	#6 by 3/8" flat head bolts with nuts & washers (for VHF BNC fitting)	
2	BNC panel mount fittings (for feedline attachment on balun boxes), SO-239 or type N connectors may be substituted (your choice)	
4	#6 x 3/8" flathead stainless steel bolts with nuts & lock washers	
6	Crimp-type closed-end connectors (for coax connections inside baluns)	
12	3/16" flat push nuts (for attaching UHF elements to boom)	
8	1/2" long 2-56 nuts and bolts (for attaching UHF balun) parts, and match bars (see text)	Radio Shack
2	3/4" long 2-56 nuts and bolts (for attaching UHF balun) parts, and match bars (see text)	Radio Shack
1	VHF-UHF duplexer (optional; see text)	

You may have to find a few assorted bolts and washers in your junk box to complete this antenna. (See text.)

Tools List

Electric drill
3/8" drill bit (for holes in boom for VHF elements)
3/16" drill bit (for holes in boom for UHF elements)
1/4" drill bit (for removing old elements from boom)
5/32" drill bit (for #8 screw holes)
Tin snips (for cutting match bar straps)
Electrical tape
Waterproof sealer (for baluns; can be spray or brush on)
Aluminum, copper, or brass sheeting (for "T" bar to driven element straps)
Drill press for drilling all holes (optional)
Solder and soldering gun (for crimp type connectors inside balun boxes)

RG-59U had a velocity factor of 66%. The number of ferrite beads is not that critical, but they do stop radiation back down the coax shield.

Be sure to drill or file the hole for the center of the BNC panel mount just big enough, but not so big that you get a sloppy fit (I had to use a butyl rubber caulk on my VHF balun box because of this). It does have to seal out the weather. Tune the antenna before you weatherproof and seal up the plastic balun boxes, in case you may not have wired the connections right. Make nice neat pigtails on your coax ends so that they will be easier to attach.

73s, and I hope that you enjoy this antenna project. If you have questions, you may write to me (please enclose an SASE #10 envelope for a reply): Marty Gammel KA0NAN, 1703 Hewitt Avenue, St. Paul MN 55104-1128.

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Grounding and Lightning Protection, Part 1

Protect your shack and yourself from lightning.

by Glen E. Zook W5UOJ

Is there really a true "science" of grounding and lightning protection? For many of us ham radio operators, grounding seems to be more of a "black art" than science. Maybe the best way to appease the radio gods would be to try a few incantations over a boiling caldron!

Now, if you believe all that, I have a bridge in Brooklyn you may be interested in! Actually, there is a kernel of truth in the above paragraph, for many things which do not seem plausible are truly affected by grounding.

First of all, the grounding requirements due to the presence of radio frequency energy are different from those required for lightning protection. Thus, two different grounding systems are needed for the vast majority of amateur radio installations: one for RF grounding and one for lightning protection.

This month we will take a concerned look at lightning; in the second part of this article, next month, we will look at RF grounding.

Protecting Yourself

At present, there are two different schools of thought on the subject. The first is to take all necessary precautions to prevent the strike; the second is to ground the heck out of everything so that if you take a strike there is sufficient protection for your equipment. Frankly, I believe in both: Take all the necessary precautions and then ground everything!

Many lightning "experts" believe that all a lightning rod does is *attract* lightning. A close parallel in the amateur radio world is the amateur with the lowly(?) ground plane or vertical antenna. On the surface, it would seem that lightning would strike this unobtrusive antenna less often than it would a large yagi array. In fact, the opposite is true!

Lightning does not start from the sky and travel downward. It appears, especially from a distance, to travel in a downward motion, from the sky to the earth, but it actually starts from the ground up. As a charged air mass (usually clouds) comes into an area, the possibility of an article on the earth gaining enough charge for a lightning strike increases enormously. The causes of this static build-up are varied, but include things like the wind blowing across the antenna.

If this static discharge is not dissipated rapidly, small "lightning bolts" called feelers start coming from the end of the antenna, tower, etc. These feelers grow longer and longer, and have a duration sometimes approaching minutes rather than seconds! Finally, these feelers are met by the primary stroke of lightning coming from the sky. Yes, the vast majority of lightning's energy comes from the sky, but without the feelers coming from the ground there would be no lightning strike.

What happens with the lightning rod or, in the case of amateur radio, the vertical antenna, is that there is very little on the end of the antenna to dissipate the electrical charge. A rule of thumb is that an item will "protect" an area equal in radius to twice the height of that item. Or, conversely, the vertical or tower will draw energy from a circle on the ground equal to twice its height (see Figure 1). For example, a 30-foot vertical will draw energy from a circle 60 feet in radius (120 feet diameter). Actually,

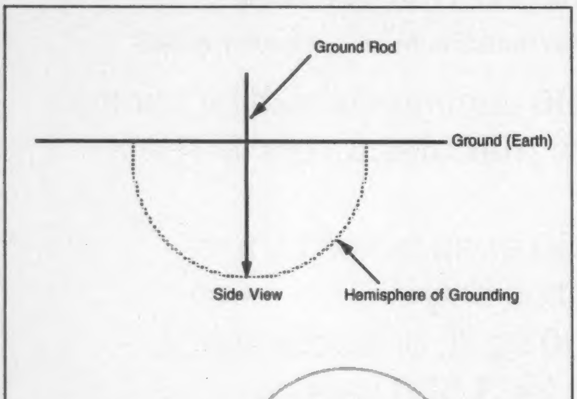


Figure 1. The hemisphere of grounding. The effective ground is equal to a hemisphere with a radius equal to the length of the ground rod.

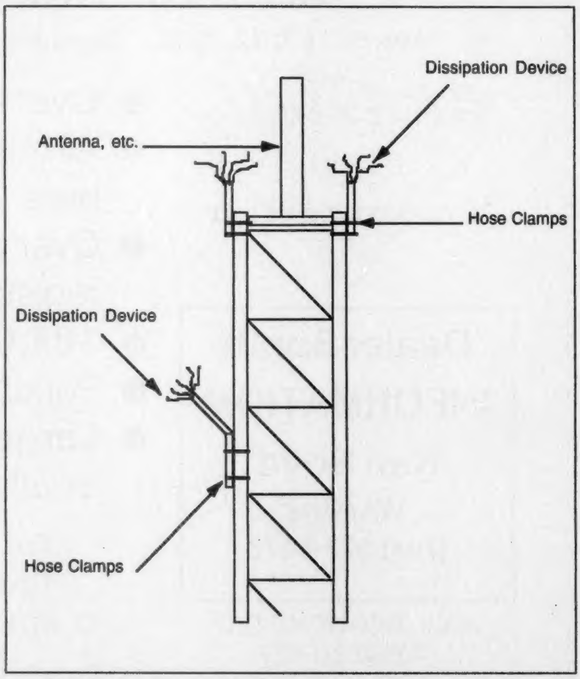


Figure 2. Placement of dissipation devices on a typical tower.

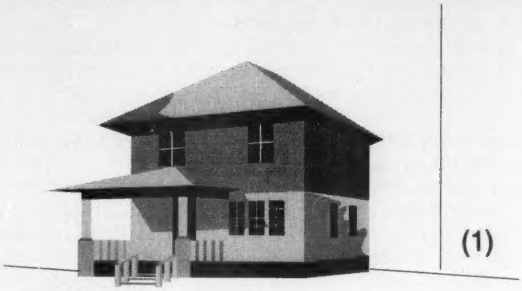


Fig. A1. The amateur radio operator adds a vertical.

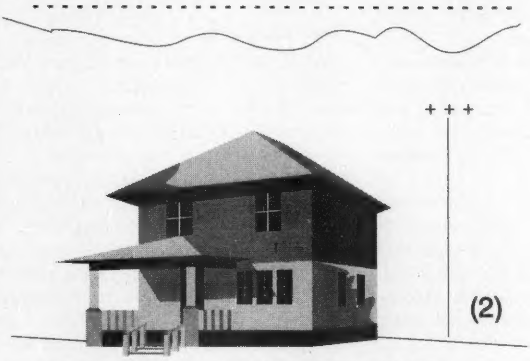


Fig. A2. As a charged mass moves closer, current flows from the earth to the antenna.

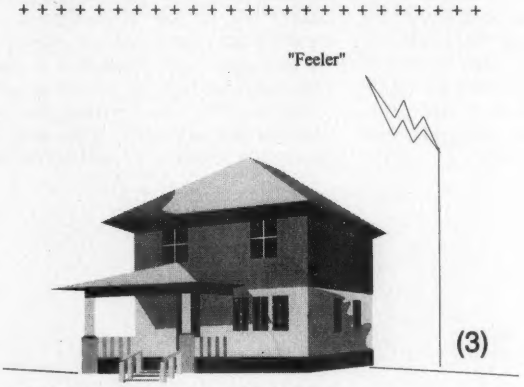


Fig. A3. As the charge increases, a "feeler" begins to form.

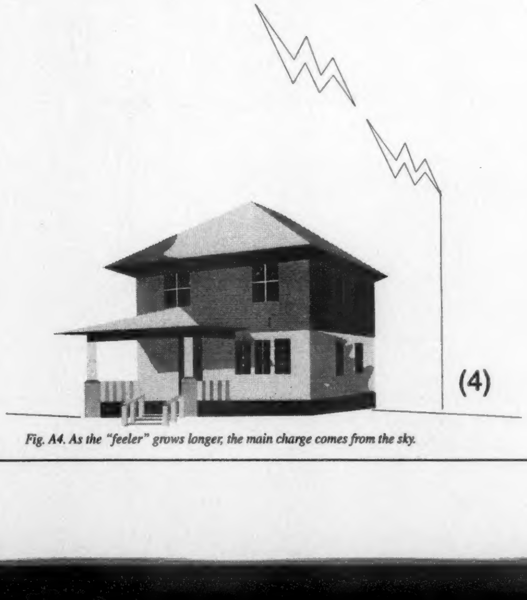


Fig. A4. As the "feeler" grows longer, the main charge comes from the sky.

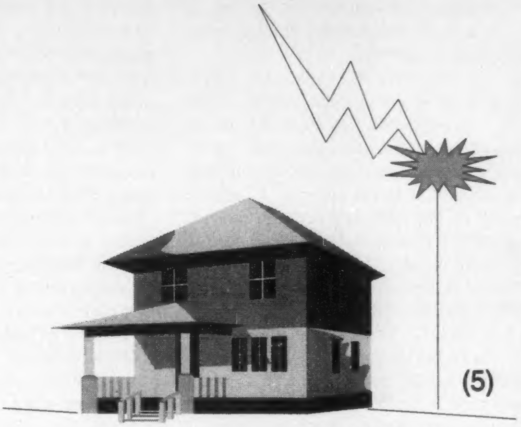


Fig. A5. Lightning strikes!

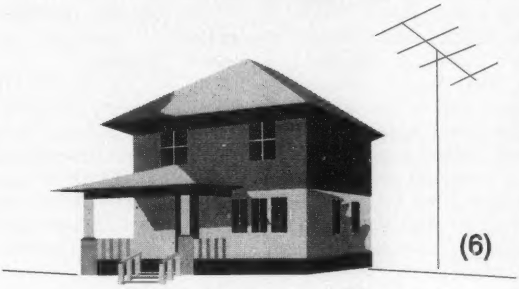


Fig. A6. The ham puts up a more complex antenna system.

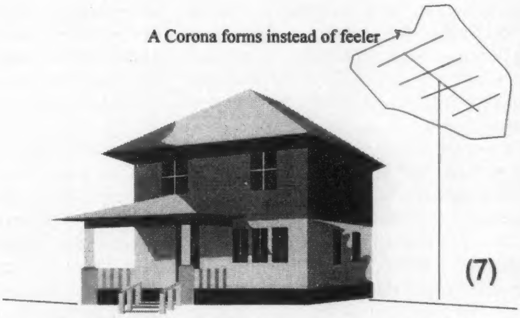

A Corona forms instead of feeler
(7)

Fig. A7. When a corona is present a feeler cannot form. Thus, there will be no lightning.

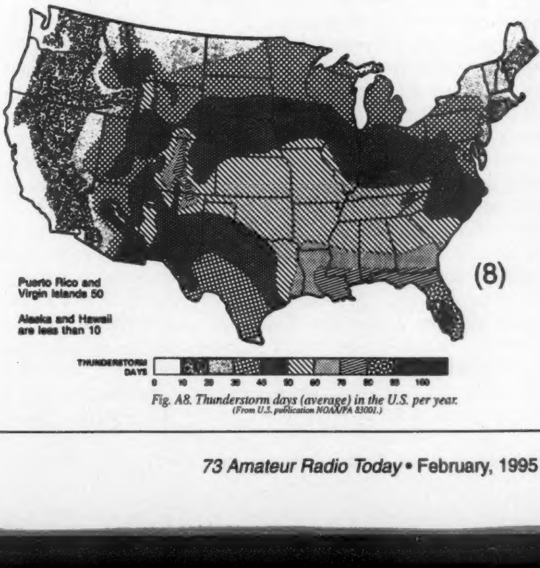

Puerto Rico and Virgin Islands 50
Alaska and Hawaii are less than 10
THUNDERSTORM DAYS
0 10 20 30 40 50 60 70 80 90 100
(8)

Fig. A8. Thunderstorm days (average) in the U.S. per year.
(From U.S. publication NOAA/PA 83001.)

the area protected is a cone with the apex at the top of the tower (or vertical), and the base of the cone a circle with a radius equal to twice the height of the antenna.

All this energy is concentrated into a very small area. In the case of a vertical with a solid top (corona ball, etc.) this is usually in the neighborhood of a square inch or so. In the case of a vertical which ends in open tubing, the actual area is in the order of 0.1 square inch, if that! The result is a very concentrated charge, which tries to make contact with the energy from the sky. This happens whether or not the end of the antenna is insulated.

With yagis, the energy is dissipated over a much larger area. The result is that there is much less chance of gaining a sufficient level of charge to get the feelers started. In the commercial radio world there are all sorts of items available to help dissipate the charge. Many of these take the form of a spline ball or some similar arrangement.

A spline ball consists of many wires or aluminum foil strips connected to a common point. This effectively increases the area of the tower, or other antenna support, and dissipates the energy built up by static. In the case of an intense electrical storm these devices may actually glow from corona discharge. This is fine, because the energy is being dissipated rapidly and will not become a feeler.

Large yagi arrays act somewhat as a spline ball, dissipating the electrical energy rapidly. However, the higher the antenna array, the more antennas are required to dissipate the energy.

Spline balls can be bought (they cost in the neighborhood of $150 apiece), or they can be built. The key to their placement is not that they be on the highest part of the tower, but that they be located near the top. In the case of antennas mounted on top of the tower you can mount a spline ball on each leg near the top of the tower and still get excellent protection. With towers over 100 feet in height, it is recommended that spline balls be placed every 75 feet. This is to reduce the charge as it is developed along the tower.

Grounding for lightning protection actually has two functions: to allow the charge built up on the antenna a ground path, and to protect in the case of a direct strike. As stated above, if you keep the charge built up from producing feelers, then you will not take a strike.

Grounds for lightning protection must be as straight as possible from the item being protected. Very gentle arcs are a must; avoid right-angle bends at all costs. A right-angle bend places a very high impedance in the ground wire, and the lightning will often jump off the ground wire and go elsewhere! Keep the ground wire in a straight line; never loop down and back. When connecting with a ground rod, bring the ground wire into the rod with nothing between the rod and wire. Clamp it very securely or thermal-weld it in place. Never bend a ground wire over 90 degrees—the lightning will continue downward, ignoring the remainder of the wire!

All coaxial type feedlines should be grounded at three points: at the top of the tower, at the bottom of the tower, and at the entry point into the building. Ground the feedline by removing the outer covering of the coax and attaching a ground wire to the shield. There are commercial attachments made for this purpose, but simple hose clamps can be used to attach the ground wire.

After attaching the ground to the coax shield, make sure to waterproof the area. Again, there are all sorts of products available on the market to do this job. One very effective method is to use the cheap black plastic tape, available for prices like 39 cents a roll, at home handyman centers (don't buy the good, more expensive brands!). This tape, after just a few days in above-freezing weather, congeals into a waterproof mass, just what the doctor ordered for protecting the ground joint.

Keep the ground wire traveling downward in as straight a line as possible until making the ground connection to the tower, ground rod, etc. A number diagrams accompany this article to show how to accomplish the best grounds possible.

The use of "CAD Welding" or other thermal bonding techniques can be used if dealing with a solid object like a ground rod. However, *never* use these techniques when dealing with hollow objects like a tower leg. The heat generated by the thermal process causes the galvanization inside the leg to dislodge, thus setting the stage for corrosion. After a relatively short time, the tower rusts from the inside out!

When clamps or bolts are used, they should be checked every six months. Just loosen and retighten the bolt or clamp to remove any traces of corrosion which may have built up. This is not necessary with the connections made to the coax shield which have been waterproofed with the plastic tape or other methods.

Each and every leg of a tower must be grounded! This includes even small towers. Bring the grounds to separate ground rods located near each tower leg. The use of rods over five or six feet long is usually unnecessary; four-foot rods give good grounds.

The power line ground must be good. At the point at which the power line enters the building a ground should be in place on the neutral. Often, this is just a piece of #14 wire clamped to the conduit entering the meter base. This, in turn, is usually clamped to a three-foot ground rod driven into the soil at the base of the meter. Replace this wire with a much heavier wire, at least #8 or larger. Make sure the ground rod is OK, and follow the rules about no large bends in the ground wire.

Anything external to the building should be grounded, including TV antennas, metal on chimneys, etc. The idea is to bleed off any potential charges which can build into those strong enough to produce the feelers which result in lightning.

There are all sorts of devices available from commercial sources which will limit the possibility of lightning strikes. But, the pricing on these is outside the budget of all but a very select handful of amateurs. Even spline balls are expensive. However, there is a method of building suitable dissipation devices.

Dissipation Device

A simple but effective dissipation device can be made from galvanized electric fence wire, a few hose clamps, and a short piece of e.m.t. (electrical metallic tubing) conduit. The electric fence wire is available in 0.25 (1/4)-mile and longer lengths at many handyman centers. In this area the price was $8.40 plus tax for a 0.25-mile roll of 17 gauge wire. The e.m.t. conduit is about $3 for a 10-foot length of 0.75 (3/4)-inch material. This is sufficient material to make a quantity of up to 10 dissipation devices. Using a hacksaw or tubing cutter, cut the desired number of pieces either 12 inches or 18 inches long. Then, cut one end of the tubing lengthwise about 3 inches with a hacksaw. It is best to cut the tubing twice, at 90 degrees to each other, but one cut will work.

Cut lengths of galvanized wire 18 inches long. Make sure there are enough to entirely fill the end of the conduit, working in as many lengths of wire as possible. When using 0.75 inches diameter conduit you can usually get in

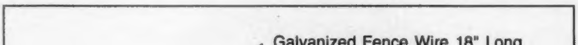

Galvanized Fence Wire 18" Long
Solder Here
EMT Electrical Conduit 0.75" Diameter

Figure 3. Diagram of a spline ball. Cut conduit 12 or 18 inches long. Split the end about 2 or 3 inches with a hacksaw. Insert wire into the conduit and secure it with a hose clamp. Solder the base of the fence wire.

at least 150 wires. If you use 0.5-inch conduit, you can get in about 75 wires. Then, secure the cut end of the conduit with a hose clamp at the very top of the cut. Next, using a propane torch and acid core solder, solder the wires right next to the piece of e.m.t.. You don't have to solder them to the conduit, but you do want to keep the wires together. Finally, flare out the wire ends to form a circle from 12 to 15 inches in diameter.

Next, this array must be mounted at or near the top of the tower. See Figure 2. If the tower height is over 75 feet, put two or more sets of dissipation devices on each tower leg, not over 75 feet apart.

When dealing with spline balls for the sides of the tower, a slight modification must be made in their construction. See Figure 3. Cut the conduit about 18 inches long instead of 12 inches. Then, at the end which has not been notched, make a 45-degree bend about 6 inches from the end. Clamp this 6 inches to the tower leg with two hose clamps. This can also be done with the devices which are installed at the top of the tower, if so desired.

Usually, the hose clamps are sufficient to make satisfactory connections between the tower leg and the dissipation device. However, ground wire (#14 is fine) can be connected between the device and a bolt holding the tower together. Drill a hole large enough to pass a #10 bolt through the conduit and attach the ground wire. Make sure the wire is connected well at both the dissipation device and the tower. You can use pieces of the galvanized fence wire for making these connections. By doing so, you will minimize the corrosion due to dissimilar metals. If you use copper wire for these connections, use a solder lug at both ends of the ground wire to prevent corrosion from the dissimilar metals.

Make sets of these devices equal to the number of legs on the tower. Usually this will mean sets of three, but in some cases sets of four. Although the use of these devices will not ensure that a lightning strike will never happen, they greatly reduce the chances (in some cases by as much as 99%) of that happening. Also, the spline balls can be used to protect wood poles by placing one at the top and running a ground wire down the side of the pole.

The devices can be attached to the tower legs by various means, including "U" bolts, muffler clamps, or hose clamps. Hose clamps are cheap and are very durable, usually made of stainless steel. These are available at any automotive store, at most discount stores, and even in some grocery stores.

Spline balls can be made from conduit which is only 0.5" in diameter. However, you should double the number of devices since they will be approximately one half the size of those made with the 0.75" conduit. Place them every 35 to 40 feet along the tower leg instead of the 75 feet placement of the 0.75" models.

Spline balls will not absolutely prevent lightning strikes. However, they will greatly reduce the probability of one because they dissipate the charge being built up on the antenna system.

There are all sorts of hints which apply to lightning protection. However, by following the guidelines outlined here you can protect yourself from virtually all strikes.

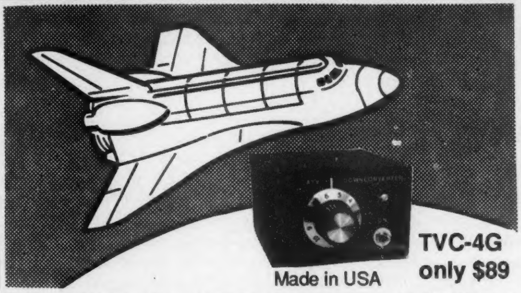
The antennas at W5UOJ consist of three towers, all on a city lot 70 feet by 130 feet. The small tower has a 440 MHz vertical with a height to the top of around 37 feet. The Hy-Gain HyTower is 55 feet tall, and the primary tower starts with a full size 20 meter 3-element at 55 feet and proceeds through 15, 10, 6, and vertical and horizontal beams for 2 meters at 67 feet. The location is just one half block from the highest point in the city, about 8 feet of elevation difference.

In over 22 years, these antennas have never been hit by lightning, even though my neighbor across the street has lost three trees and a chimney to lightning! About a year ago, the power transformer located at the back corner of the lot took a direct strike. This was about 30 feet in elevation below the top of the tower located about 60 feet away; however, the antennas were not hit.

No one can guarantee that any system is perfect. No one can guarantee that a lightning strike will never occur. But, by taking the necessary precautions to ensure that the energy is bled off, the possibility of taking a strike will be reduced greatly.

The second part of this article,dealing with RF grounding, will appear next month.

AMATEUR TELEVISION



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In the Fast Lane

February marks the fifth anniversary of the launch of UoSAT-D, today known as UoSAT-3 or UoSAT-OSCAR-14. This was the first amateur-radio spacecraft to carry an open-access 9600-bps digital trans-ponder. The RF links to and from the satellite were designed for frequency-shift keying (FSK) using 2 meters for the uplink and 70cm for the downlink. Today the satellite is only used for commercial applications on non-ham frequencies, but it ushered in an era of acute interest in amateur-radio high-speed digital communications from space.

Three satellites are currently used for 9600 bps ham operation including UoSAT-OSCAR-22, Kitsat-OSCAR-23 and Kitsat-OSCAR-25. All are in low-earth-orbit (LEO) and provide four to eight passes a day each for most earth stations. They do not operate using standard packet-radio format, but require that ground stations run specialized software on PCs and communicate with the terminal node controller (TNC) in the KISS mode.

U-O-22 is primarily used for gateway traffic. Most of the files sent through this satellite are bulletins and messages routed between terrestrial packet systems. The satellite provides an alternative to the usual shortwave connections.

K-O-23 and K-O-25 carry files posted by individuals. They act as flying mailboxes or bulletin-board systems (BBS) in the sky. Digital files of all types have been sent through these satellites. Most files are short mail messages, but many picture files using the highly compressed .JPG format or sometimes .GIF encoding have been uploaded. Voice files in either .WAV or .VOC format have been sent and many PC programs have also gone through the systems.

Just like terrestrial BBSs, if it's digital it can be loaded into the satellites, but unlike land systems, these hamsats do not have disk-drive storage. All the files are saved in random-access memory (RAM) and, due to limited storage space, will be dropped on a first-in, first-out basis.

Equipment Needs for 9600

A typical home system includes moderate to small crossed yagis or other circularly polarized antennas for 2 meters and 70cm. Right-hand circular polarization (RHCP) is adequate, but many antennas have switchers to allow left-hand circular polarization (LHCP) selection. Rotators for azimuth and elevation are needed to aim the antennas. Some rotator control boxes are configured for a computer control interface, but less expensive ones are not. Quality coax is a must at these frequencies.

Most stations use dual-band base-station radios, but lesser radios can do very well. For the 2 meter uplink all that is needed is an FM transmitter, preferably capable of 1 to 2 kHz tuning increments, with 25 watts output power. A point in the modulator section to connect the 9600 baud transmit data is required. This is usually done at the varactor diode or similar circuit just past the microphone amplifier circuits. For the 70cm receiver an FM scanner with 1 kHz tuning increments will work well. Most receivers will require a new bandpass filter to allow for the wide downlink signal and tuning inaccuracy usually caused by Doppler shift during a pass. Most ham-rig manufacturers offer 20 to 30 kHz filters for less than $10. These can be installed with little or no degradation to normal voice operation. An output line from the receiver's discriminator circuit is also needed. It is typically found on the output pin on the discriminator IC in newer radios. On older rigs the discrete discriminator circuitry can be found just before the audio output stages and routed out of the radio on a shielded cable.

Standard TNCs are usually set for 1200 baud to the radio. For 9600 work a new TNC is needed, or an older TNC can be adapted for a new high-speed modulator-demodulator (modem) circuit. Kits and complete commercial units are available from many manufacturers both for complete high-speed TNCs, or just modems. Instructions are usually included for the necessary radio modifi-

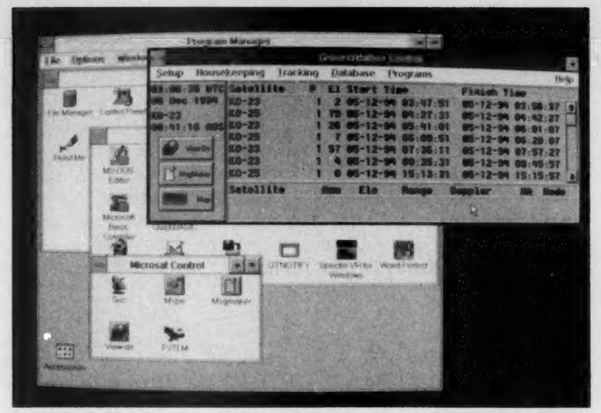
Program Manager
Setup
Housekeeping
Tracking
Database
Programs
Help
Satellite
Start Time
Finish Time
Microsat Control

Photo A: Starting the Ground Station Control program in WiSP under Windows shows a schedule of upcoming satellite passes.

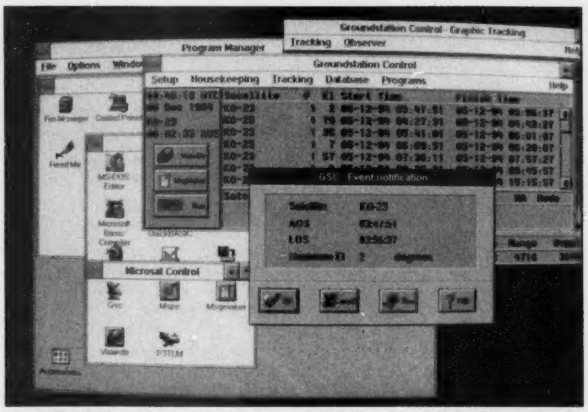
Groundstation Control - Graphic Tracking
Tracking
Observer
Program Manager
Groundstation Control
Setup
Housekeeping
Tracking
Database
Programs
Help
GSC Event notification
Microsat Control

Photo B: WiSP announces a K-O-23 pass just prior to acquisition of signal (AOS).

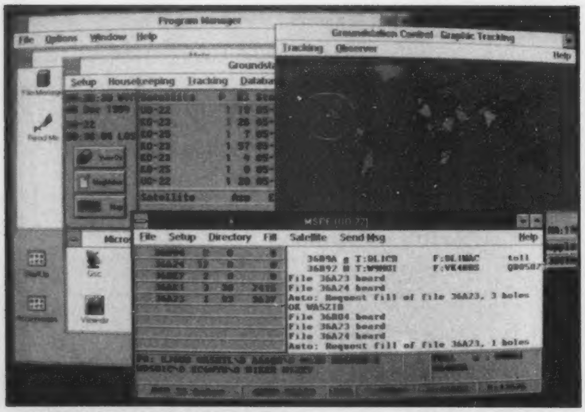
Program Manager
File
Options
Window
Help
Groundstation Control - Graphic Tracking
Tracking
Observer
Setup
Housekeeping
Tracking
File
Setup
Directory
Fill
Satellite
Send Msg
Help

Photo C: During a U-O-22 pass, files are captured and activity is monitored.

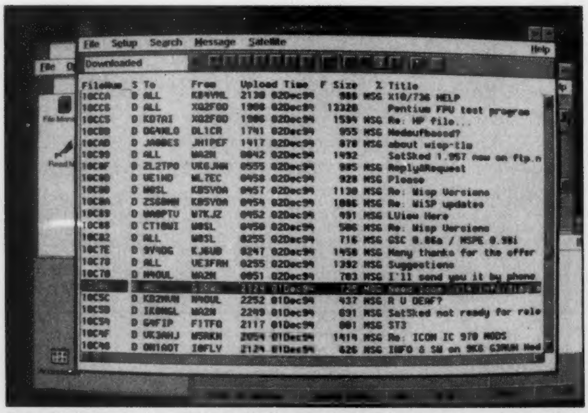
File
Setup
Search
Message
Satellite
Help
Downloaded

Photo D: Calling up View-Dir in WISP to check the files that have been downloaded.

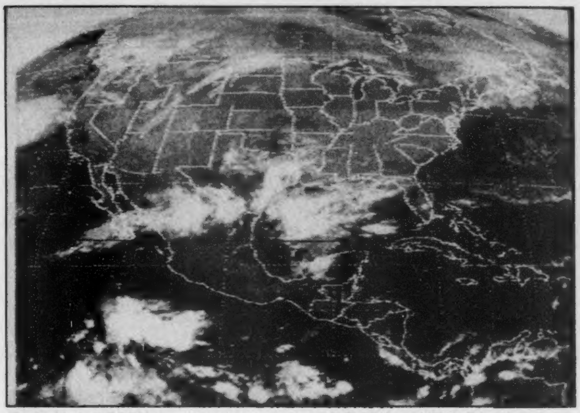

Photo E: A GOES-8 weather picture sent to K-O-25 from WB8LEM started as a 55K-byte .JPG file and expanded to a 448K-byte .GIF image.

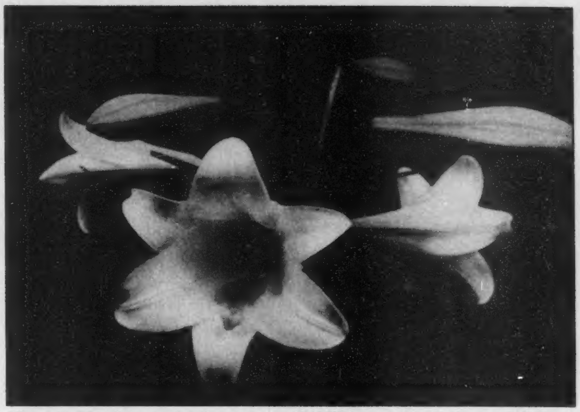

Photo F: This image of a flower from JA6VOY was uploaded as a 30K-byte. JPG file.

cations to attach the new unit. Most units are set for one or two speeds, but some incorporate digital-signal processing (DSP) chips that allow software changes to set speeds and signal types. A new modem from the Tucson Amateur Packet Radio Corporation (TAPR) is called the DSP-93. This kit costs just over $400, but shows great promise in preliminary on-the-air tests. It can run packet from 300 to 9600 baud and many other modes, depending on software availability. TAPR can be reached at 8987-309 E. Tanque Verde Rd. #337, Tucson AZ 85749-9399, and via phone at (817) 383-0000 or fax at (817) 566-2544.

The first software available for communicating with 9600 baud satellites came from the University of Surrey in England and was designed for use on IBM PCs and clones. A group of four programs allowed files to be modified and packaged for uplink to the satellite, sent to the satellite, received and then unpacked for use. The programs, PFHADD, PG, PB and PHS respectively, are still in common use today and do a great job.

PG is used to send files to the satellite and does not put the TNC in KISS mode. PB, the receive program, initializes KISS in the TNC and operates using broadcast protocol. All files and directory listings sent from the satellite are monitored and collected unless parameters are set by the user to block certain file types. Files of specific interest to the user can be tagged in the directory. The program will send a request to the satellite to download these tagged files or partial files. If the request is accepted the user will see his call in the queue of 20 downloaders. Popular files up to several kilobytes can be collected by a good system just by monitoring the downlink. Large files will require requests to be sent to the satellite to fill holes that need filling due to noise or signal dropouts.

One of the main complaints associated with the UoSAT programs was the lack of automation for file handling. To send a file to the satellite it must first be processed by PFHADD and after it is downloaded PHS must be used to unpack it. The file might have been compressed by PKZIP or LHARC, requiring further intervention. The solution was batch files to compose, compress and pack messages for uploading and post process files received during a pass. The downloaded files could be unpacked, decompressed and placed in specific subdirectories for messages, programs, images, etc.

Are You WiSP'ing Yet?

In early 1994 Chris Jackson ZL2TPO generated a set of programs for Microsoft Windows based on the wish lists of most 9600-baud satellite users. The shareware package was called WiSP for Windows Satellite Program. For computer users fluent with Windows, this group of programs is much easier to use for station control and file handling than the previous offerings.

In addition to doing all the things available with the UoSAT programs, the WiSP package includes satellite tracking software, drivers for rotator interfaces, event scheduling and message composition. Numerous help files are built in to allow the user to configure the program suite for individualized operation.

It is possible to set WiSP for completely automated operation. With the main program GSC (Ground Station Control) active, the system can launch programs to start uploads, download files, aim the antennas, control the radio frequencies, check for personal mail in the satellite directory, download any, set message priorities, unpack and sort downloaded files, and then close programs after the pass and go back to sleep until the next satellite comes by.

The capabilities are numerous. Buzz Gorsky WH6I wrote an article in the July/August issue of *The AMSAT Journal* describing he program functions and how to get initiated with the software. The help files don't provide enough details on program setup, but few "readme" files included in the package are enough to get a good Windows user started. Roy Welch W0SL, AMSATs Software Manager, is working on a more involved set of instructions based on the article by Buzz.

The complete package is available as shareware from the AMSAT ftp (file transfer protocol) site on the Internet. The address is ftp.amst.org. If this doesn't work, use the IP (Internet Protocol) address of 192.35.156.5. Answer the user name query with "anonymous" and password request with your Internet address. The WiSP programs are in the subdirectory amsat/software/windows/wisp. To register shareware the donation is $40 to AMSAT, 850 Sligo Ave., Suite

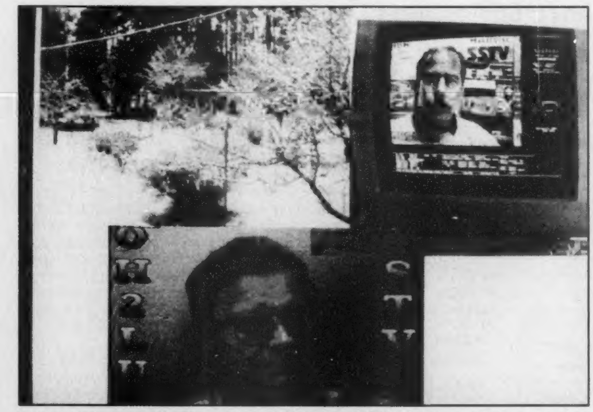

Photo G: A composite picture from OH2LU to VK3AHJ included a text message describing SSTV activity on HF.

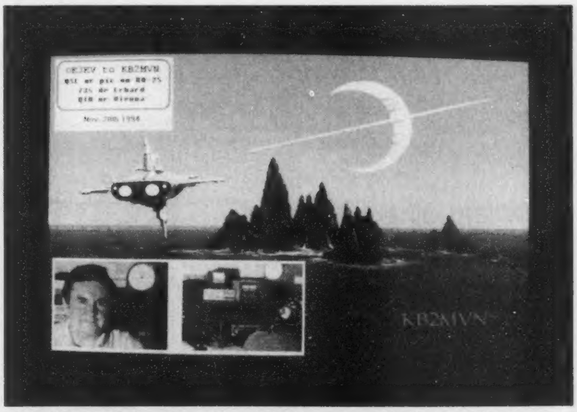

Photo H: OE3EV downloaded the original image from KB2MVN, added some pictures of his own and resent it via K-O-25 as a 98K-byte .GIF file.

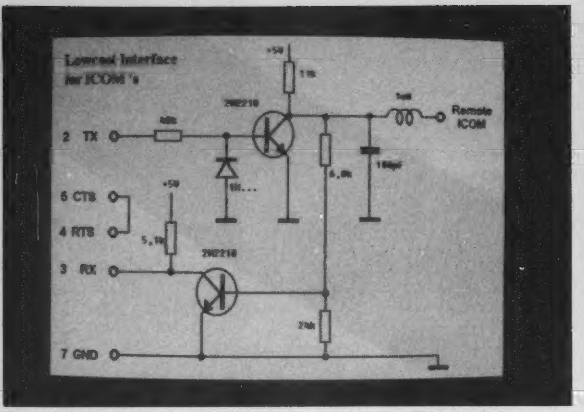

Photo I: Schematics in many forms are sent via satellite. This simple one was a 6K-byte .GIF file from OE3EV.

Photo J: EYE.GIF from VE3EGO started as a 41K-bye .JPG file sent via K-O-25.

600, Silver Spring, MD 20910, or via phone at (301) 589-6062. A special individual code will be given upon registration that will identify the software on the air as registered and remove the annoying message that appears when the program starts. To get the registered programs on disk the cost is $50. Donations are earmarked for the Phase 3D satellite program.

The WiSP package is continually changing. Since the *Journal* article, drivers for the Kansas City Tracker rotator interface have been added along with support for serial port line connections for control functions on most newer satellite rigs. Telemetry decoding has also been added. Updated versions of the programs are routinely uploaded to K-O-23, K-O-25 and the AMSAT ftp site.

Chris ZL2TPO is geting married and moving to England and a new job at the University of Surrey. New versions of WiSP will come less often for a while. Perhaps is time for a new wish list. Wouldn't it be nice if the program could take freshly downloaded picture files, put them in little windows on the screen and then read any attached message files through the sound card? What else . . . hmmm.

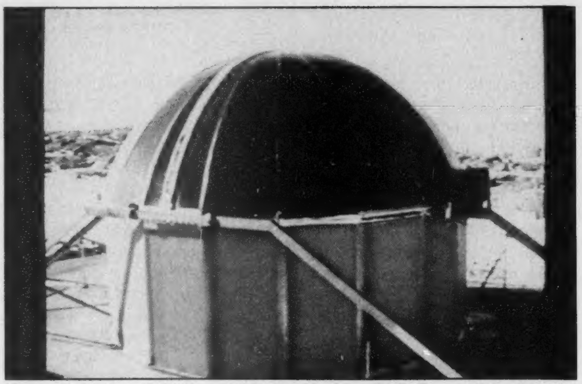

Photo K: Gianluca IKØAIH sent this picture of the OASI Osservatiorio Antartico from his QTH at Terra Nova Bay on the Ross Sea in Antarctica via K-O-23.

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MPD-3712	30, 17, 12M Max-Performance Dipole, 31' long	$73.00
HPD-3*	160, 80 40M i-Performance Dipole, select 113' or 125'	$83.00
SSD-6	160, 80, 40, 20, 15, 10M Space-Saver Dipole 71' long	$146.00
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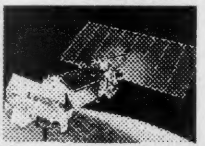

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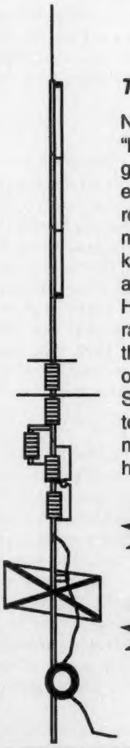

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Filter Design Software

A couple of years ago I purchased a printed circuit layout software package from a British company called Number One Systems, Ltd.

The advertising that was packed with the software listed several other packages, two of which were reviewed in this column previously (Z-match and Analyzer III). Recently I obtained a copy of another of the Number One Systems programs: Filtech. This program is designed to take the "black artness" out of designing filters.

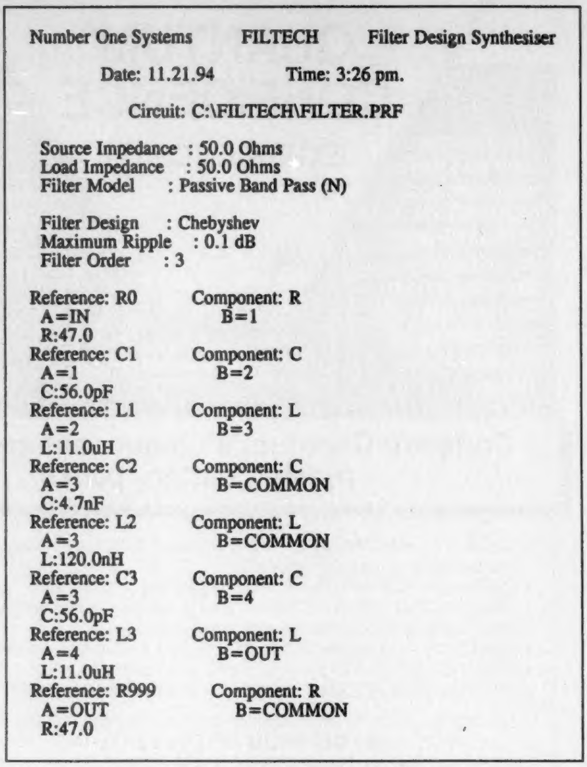
Filtech will accommodate both passive and active filter designs, and schematics for each are given in the manual. A passive filter consists of only resistors, capacitors and inductors. An active filter includes some amplifying device such as a transistor or (more commonly today) an operational amplifier. With Filtech one need not resort to performing complex mathematics, or looking up "normalized" values in a table: The software does it for you. In addition, while the tables (as published in the *ARRL Handbook*) are relatively easy to use, they become a lot less convenient when comparing different filter designs. Also, the look-up tables don't take into consideration what happens when you use standard value, kind-you-can-actually-buy values rather than the computed values. Filtech solves these problems.

With Filtech you select a filter type (Bessel, Butterworth, Chebychev), or ask the program to recommend a type. You can set the ripple factor permitted (0.1 dB, 0.25 dB, etc), and set the frequency parameters. The program makes its calculations and displays the frequency response characteristic on the screen. It will also create a "net list" of preferred components.

Figure 1 shows the frequency response screen (and print-out) that Filtech provided for a 40 meter bandpass filter centered on 7.15 MHz. Overlayed are the ideal design passband and the passband of the version built with real components. Note that decibels (dB) of attenuation are along the vertical axis and frequency is along the horizontal axis. This particular filter was specified with 50 ohm input and output impedances (which is customary for RF filters). The net list of component values is shown in Figure 2. The component numbers refer to schematic values (see Filtech documentation for schematics). Passive filter responses for the audio range are shown in Figure 3 (low-pass) and Figure 4 (high-pass).

One aspect of Filtech that makes it quite a bit more useful and more powerful is that it interfaces seamlessly with Analyzer III (also by the same company), which is a network analysis package.

The only problem that I had is that it would not load on my computer. Filtech is an MS-DOS program, and some Windows machines (like mine) have too much stuff crudding up the lower 640K of memory that is used by MS-DOS. I dealt with the problem by creating a special CONFIG.SYS file for MS-DOS-only programs (see this column last month).



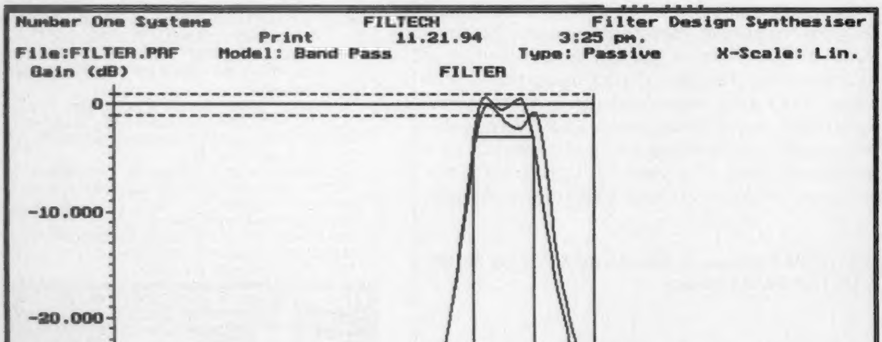
```
Number One Systems        FILTECH        Filter Design Synthesiser
            Date: 11.21.94          Time: 3:26 pm.
                 Circuit: C:\FILTECH\FILTER.PRF

 Source Impedance  : 50.0 Ohms
 Load Impedance    : 50.0 Ohms
 Filter Model      : Passive Band Pass (N)

 Filter Design     : Chebyshev
 Maximum Ripple    : 0.1 dB
 Filter Order      : 3

Reference: R0           Component: R
  A=IN                      B=1
  R:47.0
Reference: C1           Component: C
  A=1                       B=2
  C:56.0pF
Reference: L1           Component: L
  A=2                       B=3
  L:11.0uH
Reference: C2           Component: C
  A=3                       B=COMMON
  C:4.7nF
Reference: L2           Component: L
  A=3                       B=COMMON
  L:120.0nH
Reference: C3           Component: C
  A=3                       B=4
  C:56.0pF
Reference: L3           Component: L
  A=4                       B=OUT
  L:11.0uH
Reference: R999           Component: R
  A=OUT                       B=COMMON
  R:47.0
```

Figure 2. Net list for the Figure 1 filter.



```
Number One Systems            FILTECH            Filter Design Synthesiser
                   Print       11.21.94        3:25 pm.
File:FILTER.PRF    Model: Band Pass            Type: Passive      X-Scale: Lin.
<L.Stop: 7.150 Hz   L.Pass: 6.000 MHz   U.Pass: 7.000 MHz   >U.Stop: 8.000 MHz
Zsource: 50.0 Ω     Zload: 50.0 Ω       Attn: 25.0 dB       Ripple: 1.0 dB
```

Figure 1. Bandpass filter response.

The company has offices in both Great Britain (UK) and the United States (USA). Address in UK: Number One Systems, Ltd., St. Ives, Huntingdon, Cambridgeshire PE17 4WR, England, telephone 011 44 1480 461778. Address in USA: Number One Systems, Ltd., 1795 Granger Avenue, Los Altos, CA 94024, telephone (415) 968-9306.

Contact the company for prices, or alternatively, check the Number One Systems ads in recent issues of this magazine.

In upcoming months we will take a look at the upgrade Easy-PC Professional XM by Number One Systems, and Electronic Workbench by Interactive.

Other Software . . .

A number of readers have commented positively on my Antlers for Windows 2.00 software. It is designed to calculate the lengths, spacings and so forth for a variety of antennas including dipoles and verticals of various types, beams (quads and yagis), and both large and small loop antennas. The price is $30. Contact me at P.O. Box 1099, Falls Church, VA 22041 if you're interested in Antlers for Windows 2.00.

Soap-Box Time . . .

Every time I go to the local ham radio stores I am disheartened by the lack of younger hams. As one of the graying heads of ham radio, I wonder how long the FCC is going to permit hams to use valuable spectrum space when the population of ops is both aging and reducing in numbers. The FCC is now of a mind to raise money by auctioning off frequencies, and ours look too plump to remain ours for long . . . especially if we don't use them.

We cannot always use the public emergency and public service excuses to hold onto our privileges. After

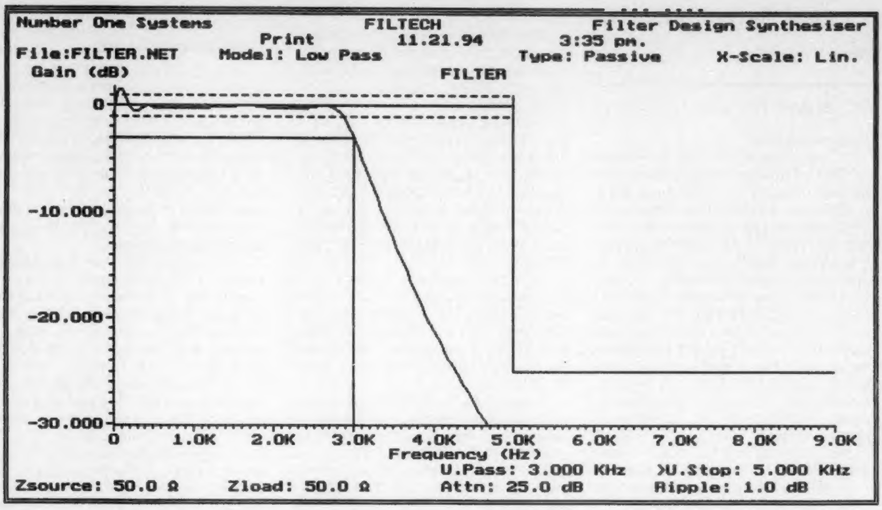


Figure 3. Low-pass audio filter response.

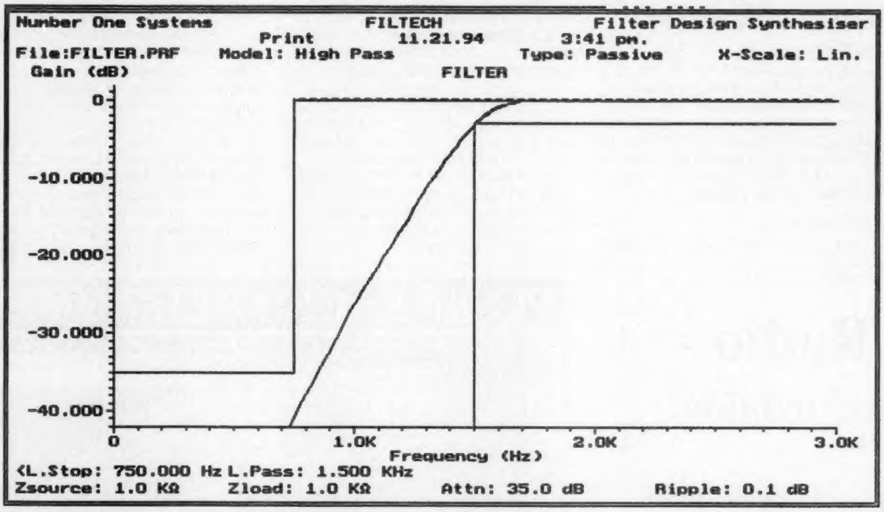


Figure 4. High-pass audio filter response.

all, cellular telephones can provide communications at sports car rallies, and a laptop computer connected to Internet through a cellular telephone can handle a lot of the health and welfare message traffic that we used to handle . . . without getting a ham license!

One way to build the numbers of licensed hams as well as increase the usage of our bands is to recruit new licensees. We will be a lot more challenging with higher numbers and an increasing population. My challenge to you (as in the past) is to replicate yourself: Actively mentor someone to get a ham license. Whether it is a kid down the block, or a colleague at work, or your spouse, it is worthwhile to proselytize for the hobby.

Look to both shortwave listeners/ scanner buffs and to computerniks for new members. Also look to electronic hobbiests who are not hams. The ARRL is not taking the lead in this effort, even though they should. In a rather shabby *QST* review of one of my books (which drew comments from Harry Helms about the league's lack of integrity on book reviews) the reviewer made the incredible comment that suggested SWLs are ham wanna-bes. Wanna bet? There is a huge number of SWLs who are not striking for ham radio . . . and they are a prime source of recruits if we don't treat them with contempt.

Also, when I write an RF construction project for my column in another (general electronics) magazine, the number of letters I get are seven nonlicensed (or at least no callsign in the letter or return address) to five licensed (callsign listed in letter or address). Why aren't we recruiting them? Perhaps they hear those incredibly rude bozos on 75 meters and 40 meters and prefer to shun us as impossible boors. We will have the ham radio future we deserve! ■

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I'm sick. No, I mean that literally. I've had strep throat, been down for the weekend, and somehow managed to be at my daughter's birthday party, although I am not sure that I remember it all. I'll have to watch the videotape. Anyway, you might ask, what does that have to do with this column? Well, I don't know about you, but when I am feeling badly I often cuddle up with an old magazine or some neglected mail and see what's happening.

RF Problems

That is how I came across the Email received from Jack Phillips KD4VRD, JackKD4VRD@aol.com, who states that he is a new RTTY operator, having just gotten his PK-232 at the end of October. He has had a little trouble getting the tones to be clean, and wishes to share his trials and tribulations with all of us.

"I operated RTTY at first on my IC-737 with no problem. I then operated some VHF packet and went back to RTTY and the tones were garbled. I had moved the drive level on the TNC to work with packet and it was garbled on HF. I asked the ARRL Tech rep for our area, Gene Wood WA4PGI, for help and he put some bypass capacitors on the audio line and eventually put a resistor in the audio out lead on the HF rig. Works great now. I was getting a little RF into the shack. Some folks may forget about these simple fixes.

"I really enjoy RTTY. I got my license in 1992 as a no-code Tech, along with my wife, Pam. We both have upgraded to Advanced and anticipate Extra Class by Christmas. I have gone back to the last two years of *73* magazine issues and started reading your column over again. Lots of good information. Do you ever mention any RTTY nets in your column? I have checked into the Midwest RTTY net and found it quite helpful in learning RTTY and getting everything set up well. Even found a guy with my exact rig and TNC set up to bounce problems off. The MRN meets every night at 8:30 p.m. EST on 3.607 MHz plus/minus QRM."

Well, Jack, as you found out, simple problems often have simple solutions. And, most importantly, don't forget that this is, after all, RF we are playing with. In the old days an AM signal might be messed up by RF coming in on the mike line. These days, a little RF on the input can wreak havoc with communication.

New Net

A few years ago I tried to include a listing of RTTY and/or packet new frequencies. I have, to date, received very sparse information. So, I gladly pass along the information on the Midwest RTTY Net, and let that be a stimulus for other net operators to send me along the information on their groups.

Mac Software

Then there was the Email from Ralph Howard WD6BGN/CE8, who is aboard the good ship *Duke*, working in the Antarctic, who wonders about the availability of software for the Mac.

He writes, "I have played with RTTY since I had a Model 15 in the '70s. However, I haven't done much for the last few years. Packet just isn't a good substitute. Anyway, in the May issue you mentioned some fax software for the PC. Is there anything out there for the Mac? I have a Powerbook and, with the mike input, it should be a natural for RTTY, fax, CW, etc.

"With the concept of a 'software filter' no electronic interface is possible with the new Macs. Do you know if anyone has done it? I think I have seen some stuff for the SoundBlaster card for the PC. However I haven't seen anything for the MAC.

"I don't have a rig on board at this time, however I will be back aboard in January, and plan to bring my rig then. (Yaesu FT-80, KAM, etc.) So will be looking forward to talking to you on the green keys. (Uh, gray now I think, however these are sort of a dirty beige.)"

Well, Ralph, while I agree with you that the audio-equipped Mac should be an ideal RTTY machine, a scan of my local sources has failed to turn up any programs that meet this need. Or, at least I should say, failed to turn up any programs the descriptions of which allow me to know that they meet this need. Logging programs, communications programs for use with various interfaces, TNCs, or modems? Sure. But interfaceless RTTY programs? None found.

So, I await the proverbial flood of mail that will turn me on to the veritable plethora of software solutions that are out there, even as I pen (all right, type) this column. Stay tuned!

Other Requests for Help

Just to prove that *73* does get around, I received a letter from Sontaya Kumsan HS2KSP in Bangkok, Thailand. Sontaya writes that he is interested in RTTY and related modes, but that there is little local activity on the digital modes. He is looking for any help, locally or otherwise. A letter to 25 Moo 2, Hopukchaisavadisuk, Lad Krabang District, Bangkok, Thailand 10520, would certainly be appreciated.

I received a question on SuperMorse, version 4.15, mentioned here a few months back. One reader asks about the computer configuration required for this program. Well, it requires only 384K of memory, and supports a floppy disk or hard drive. The monitor may be monochrome or color; a standard mouse is also supported. Full use of SuperMorse features requires three serial ports, with a standard Sound Blaster configuration. Please note that while the program supports the Sound Blaster, it does not require this card. Of course, the program is easily obtained as one of the programs on Disk #7 of the "RTTY Loop" Software Series.

Of course, the overall interest in these now seven volumes of "RTTY Loop" software continues. The contents of many of the disks have been described in previous columns, but you can send a self-addressed, stamped envelope to me at the above address, or direct Email to me at CompuServe (75036,2501), Delphi (MarkWA3AJR), America Online (MarcWA3AJR), or via Internet (MarcWA3AJR@aol.com). As always, I look forward to your comments and questions, as well. Drop me a line and, who knows, you might just jog this brain of mine into action!

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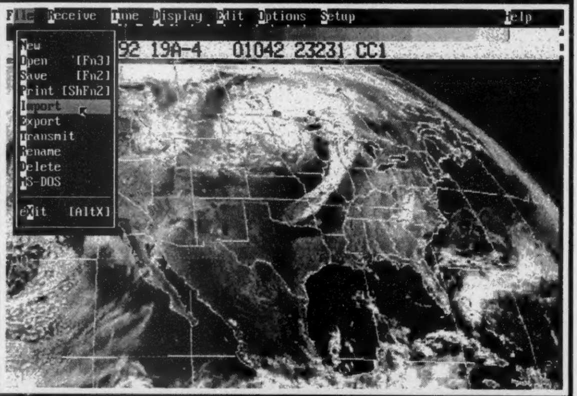

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New Resources

During the hot, sultry days of July last summer, I began my search for new and interesting books and resources to use with my ham radio classes. It's very important that we who are educators keep ourselves stimulated and always on the alert for innovative materials. A teacher or instructor must never become complacent about his or her subject area. Certainly, the teacher who uses amateur radio in the classroom has a plethora of materials at his disposal if only he will be creative in his approach.

There are many excellent commercially-prepared books and curriculum packages for classroom use. I think it is incumbent upon those of us who are involved in teaching amateur radio to stay abreast of new technical books that come out each year. Two new books caught my eye this summer which I'll share with you.

Eyewitness Science-Electronics

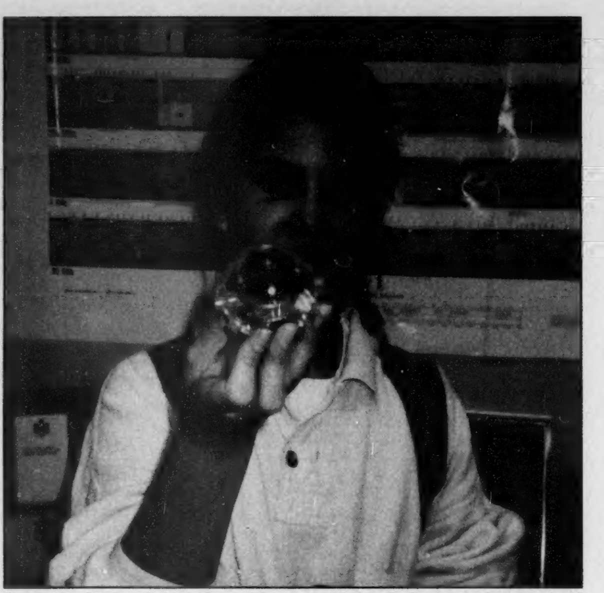
The first book is *Eyewitness Science-Electronics* by Roger Bridgman, published by Dorling Kindersley of New York. The Eyewitness Science series is a highly informative series of books that traces the story of science from the ancient world to the present day. The *Electronics* book answers the questions, "What makes something electronic?" "How big was the first computer?" "How can a computer stop traffic?" "Why are microchips made out of silicon?"

Some of the really interesting chapters include: the preelectric world, electricity and magnetism, the importance of frequency, building circuits, communicating with electricity, development of the transistor, translating useful signals, analog and digital, signals and codes, integrated circuits, how electronic devices remember, microprocessors, and the future of electronics.

This beautifully-designed book will make a big hit with the children in your class. It is an excellent reference book with state-of-the-art photography. Superb full-color photography of original equipment, intricate scientific instruments, and 3-D models brings to life the ideas and discoveries that have influenced modern technology.

Connie Dunn KB5LES

My dear friend Connie Dunn KB5LES has come up with some very creative materials for introducing amateur radio to young children. When Connie goes into a school to demonstrate the fun of the radio, she takes puppets along with her. She brings Amanda Radio, who is an oversized replica of a hand-held. Sometimes she also brings Danielle, a very talkative and curious monkey. Amanda Radio actually tells the kids a story from a Big Book.



Samantha Speirs, sixth grader, holds up a crystal radio from a project in a book from our Resource Center in the classroom.

Connie has published a delightful reading and coloring book for young children called *Sam and Erin Go to a Hamfest*. The book includes a package of Crayolas and costs $5 plus $2.50 for postage. It can be ordered from Media Mentors, P.O. Box 131646, Staten Island, NY 10313-0006; Fax or phone (718) 983-1416.

Children are exposed to terminology used in amateur radio. They are taken through a hamfest where Erin finds out about flea markets, SAREX (Shuttle Amateur Radio Experiment), Elmers, ARES, Skywarn Spotters and callsigns. For teachers of lower grades, or those of you who can't wait to initiate your own youngsters or grandkids into the field, you'll be giving a wonderful gift with this book.

A major part of keeping children excited and eager to learn and participate in amateur radio is to provide resources and materials that are continuously updated and are challenging for them. I would feel as though I weren't doing my job properly if I didn't add at least two new items to my classroom reference section every year.

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The Xplor 32CA

I promised this month to have something rather different. I've got my finger deep inside the world of microprocessors. Yes, it is 1995 and there is more to QRP than NE602 mixers and 2N2222s. I don't know right offhand if I'll ever put this thing to use inside a QRP rig, but oh, I do have lots of ideas!

The name of the project is the Xplor 32CA. It's a Personal Digital Controller (PDC) that provides a low-cost general-purpose programmable control device. It's primarily used in control applications of moderate complexity. The Xplor 32 may become the brain for hundreds of QRP projects. I know Bill Brown WB8ELK has used one of the Xplor's bigger brothers to measure and then transmit the air pressure in many of his high-altitude balloons. The Xplor 32 is available from Blue Earth Research. The basic unit goes for about $80.

The Xplor 32 operates from an 80C32 microprocessor. The BASIC language used in the Xplor 32 is Tiny BASIC (TB52). This TB52 also has the ability to upload HEX files in an Intel compatible format. If you're up to it, you can also use assembly language to access the 80C32 µPC.

There is an 8K byte EEPROM that holds the resident program. An 11-channel, 10-bit A/D converter, and up to 24 digital I/O lines are possible. You can even use an adjustable wake-up timer for low-power applications. Also, depending on the selected unit, a built-in temperature sensor and humidity sensor are possible. Both sensors are available from Blue Earth Research.

Each of the 10-bit A/D converters has an input of 0 to 5 volts, with a resolution of about 5 millivolts. All of the A/D converters can be read directly from the Tiny BASIC. It's really simple to read any of the A/D converters. For example, 10 A=chan 0: print 0. This one line will print the value of A/D channel 0. The return will be a number from 0 (O volts) to 1090 (5 volts).

Talk To Me

The Xplor 32 communicates to the world via an on-board RS-232 port. A 9-pin DIN plug connects the Xplor 32 to any computer with an RS-232 port. In my case, I used a rather old Tandy 1100 FD laptop. This guy has no hard drive, so everything runs from one floppy. The software you can buy along with the Xplor 32 is very simple. It's really only a communications program. In fact, you can use the popular ProComm terminal program with the Xplor 32. Configure your communication software to 9600 baud, 8 bits, no parity, and one-stop bit.

What's slick about the Xplor 32 is its ability to operate *without* any terminal or computer being attached to the RS-232 port. You can power the Xplor 32 down, and then three hours (or three weeks) from now apply power and the program you uploaded will start working. The resident program will *always* be executed on power-up.

The Tiny BASIC does have limits. It does not support floating point numbers. Divide 10 by 3 and you get 3, not the 0.333333 you would normally see. The MOD command allows you to see the remainder from division.

Aside from the Tiny BASIC, you can CALL a number of assembly language programs. These are very useful when using an LCD display or a keypad. For example, a CALL 8132 will initialize the LCD display. CALLING 8134 will clear the LCD and place the cursor at the home location. A CALL 8140 will scan the keypad for a key press, and so on.

The Xplor 32 requires 6 to 9 volts DC. A wall wart-power supply is all that is required to operate the PLC.

Putting the Xplor 32 to Work

I'll freely admit, I know just enough BASIC to do damage. I'm no Bill Gates. But even I've been able to do many things with the Xplor 32. Right now, my goal is to have a data collection for my solar array. Down the road, I will be using the Xplor 32 as a portable data collection device for solar arrays. In the sidebar, you'll see the code that writes four of the A/D converters to the LCD. It's nothing fancy, and in fact, this code took several phone calls to Blue Earth for some pointers. The support Blue Earth gives their customers is just great. I know, they were fighting over the phone for me. (It's your turn, I talked to him twice last time.) If you have an application that needs custom work, the staff at Blue Earth Research can more than likely help you out.

For me, the data collection on my solar array is working out just fine. I learn each time I key in something new. What can you do with an Xplor 32? Well, plenty; it's all up to you.

I see no reason why you could not use an Xplor 32 to monitor your antenna system SWR. By reading in the reflected power VSWR (you might need a op-amplifier to up the resulting value to something useful) and then do an IF statement on the reading from one of the A/D converters. It would look something like this:

```
10 A=chan 0
20 If A < 100 then bit 144=1
30 IF A > 250 then bit 144=0
40 GOTO 10
```

What I've done is set the first A/D converter to a variable called RAS. Next, I told BASIC as long as A/D converter 0 is less than 100, make bit 144 a logical high. The next line tells basic if the A/D converter is over 250, then make bit 144 a logical low. Line 40 loops back and starts things all over again.

So, when the SWR is high on your antenna, the reflected power would produce a higher voltage from the RF sensor. This voltage, being monitored by A/D converter would keep port P.0.1 high until the SWR exceeded the A/D converter count of 250. At which time the port would go low. Now, you can do anything you want with the port, such at turn on a relay, sound an alarm, or whatever. As long as you operate the I/O port within its current and voltage rating.

Here's an idea! Since most of the rotor controls return a voltage determined by the position of the antenna, you could use the Xplor 32 to control your rotor. By keying in the desired degree, an I/O port would go high until the returned value from the rotor's pot equals the desired setting. All you would need to do is read the keypad, one or two A/D converters and use the proper I/O lines to control the rotor. How about satellite tracking using two rotors? You have plenty of I/O lines and A/D converters to do it.

Will you be seeing an Xplor 32 in an upcoming QRP transceiver? That's hard to say. You just might. But, if nothing else, it's a great learning machine. I still know nothing about assembly but I can talk to my Xplor 32 in BASIC to begin making some interesting projects come to life.

Yes, there is more to QRP than just NE602s and transistors. If you ever get the chance to play with an Xplor 32, it's great fun! If nothing else, it will give you something interesting to talk about during your next QSO! You can always tell when I'm working on the Xplor 32 in my shack: There are the remains of several Oreo packages, as well as many dead Diet Coke cans, laying about.

Since my wife works some strange hours as a fish cutter (don't ask!) I usually have a Saturday night free to myself. When she leaves for work at 3 p.m. and then comes home at 2 a.m. she will say, "I see you have not moved all night. You still have your fingers in that thing?" Of course, I alway reply, "All the way up to my elbows!" 73

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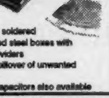

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Track It With Packet

In the heyday of spy movies and TV shows a couple of decades ago, the hero often had a sophisticated-looking device on the dash of his sports car. It received transmissions from a "bumper beeper" transmitter on the bad guy's car and displayed his exact location as they chased through the streets. The real radio direction finding (RDF) methods of the time didn't have enough accuracy to actually pinpoint cars this way, of course, but it made good fiction.

Tracking systems with this level of speed and accuracy became a reality in this decade, but they don't use traditional azimuth-triangulation RDF. For instance, the Teletrac Vehicle Monitoring System utilizes the difference in time arrival of the target's UHF pulsed transmissions at four or more receiving sites. For a complete description, see "Homing In" for July 1991.

In some other vehicle tracking schemes, the target determines its own coordinates using the Global Positioning System (GPS) and transmits them to the trackers. GPS technology is also at the heart of computerized navigation systems being developed for autos of the future. You may have had the chance to try one already—they are available on rental cars in some places to guide you in unfamiliar territory.

Wouldn't it be helpful (and lots of fun) to use this technology in ham radio? Imagine knowing the exact position and altitude of your club's ATV helium balloon packages throughout their flights, displayed on a computer map in every chase car along with the positions of each vehicle, as shown in Figure 1. If public service is your favorite activity, how about having instant updates on the locations of marathon runners, ambulances, and volunteer hams, mapped on the screen of your laptop computer, as in Figure 2.

Automatic Packet Reporting System (APRS), a shareware PC mapping and messaging program invented by Bob Bruninga WB4APR, has brought GPS and packet radio together to do all these things. "Homing In" for October 1994 and January 1995 introduced you to APRS, which some hams pronounce "A-pers." This month, we'll see how easily an APRS network fits into public service activities and look closely at the new Macintosh version of the program.

Where Is Everybody?

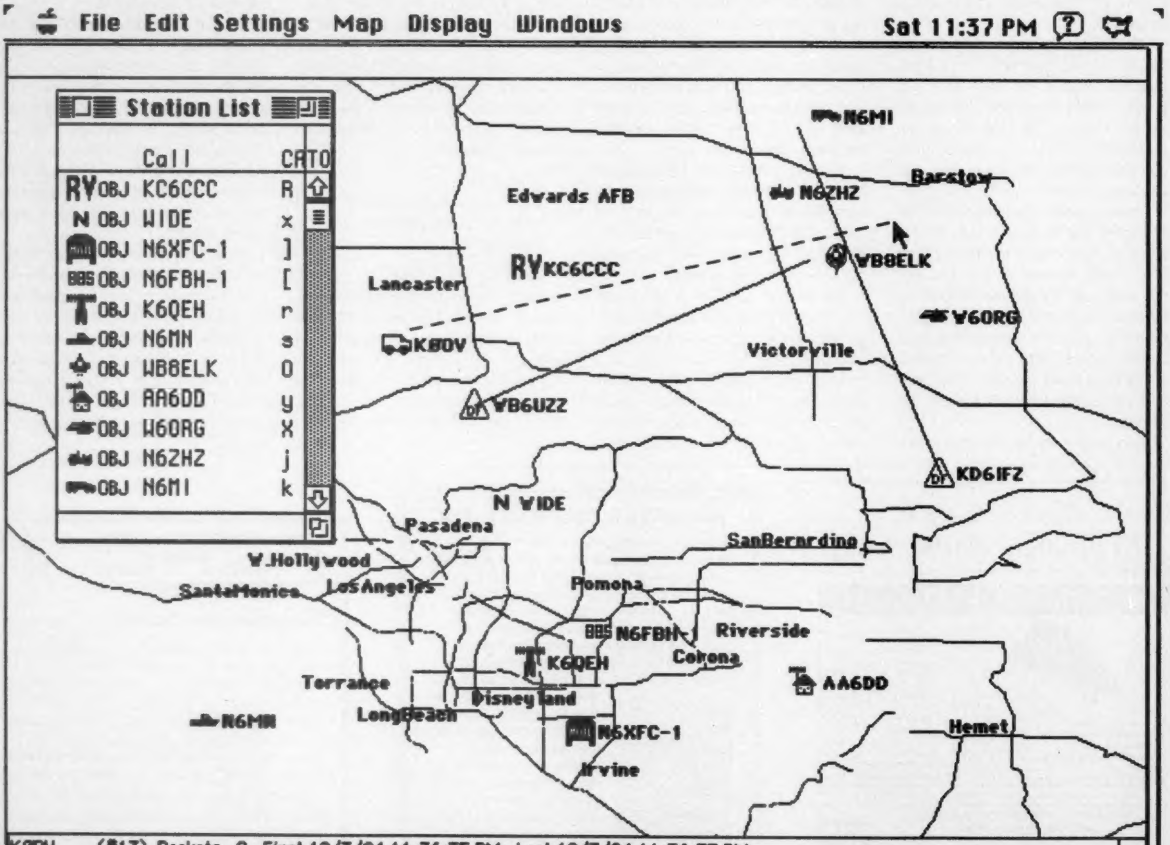
Most VHF packet stations use a "smart" device called a Terminal Node Controller (TNC). It ties the mike and speaker connections of the transceiver to the serial port of a computer. The TNC does the hard work of making packet connections, assembling/disassembling packets, and error-checking. The computer loafs, running a simple terminal program to display the TNC's ASCII output as letters and symbols on the screen, while passing keyboard input to the TNC.

APRS replaces the terminal program. It accepts your position data and other information as appropriate (course, speed, weather report, RDF bearing). It then encodes the data into APRS format and commands the TNC to beacon it to the packet network. Incoming packet position reports from other stations in the net are passed by the TNC to the computer, where APRS decodes the data and displays it on special APRS maps.

If you are stationary, all you have to do is type in your latitude/longitude coordinates to put your electronic pin on everyone's map. If you are moving, you can update your position automatically and continuously by hooking a GPS receiver's NMEA output to the second serial port of the APRS computer. Read last month's column for more on GPS receivers and their serial outputs.

Besides your own position, you can enter and transmit the positions of other "objects," as they are called in APRS-speak. Does this sound like an ideal way to use packet radio for public service race communications? APRS creator WB4APR thought so. In recent years, Bob and his friends have used his PC program in marathons, regattas, bicycle races, and even to track the ceremonial 128-mile game ball relay for the Army/Navy football game.

An unattended station does not have to have an APRS-running computer to be tracked by the net. For

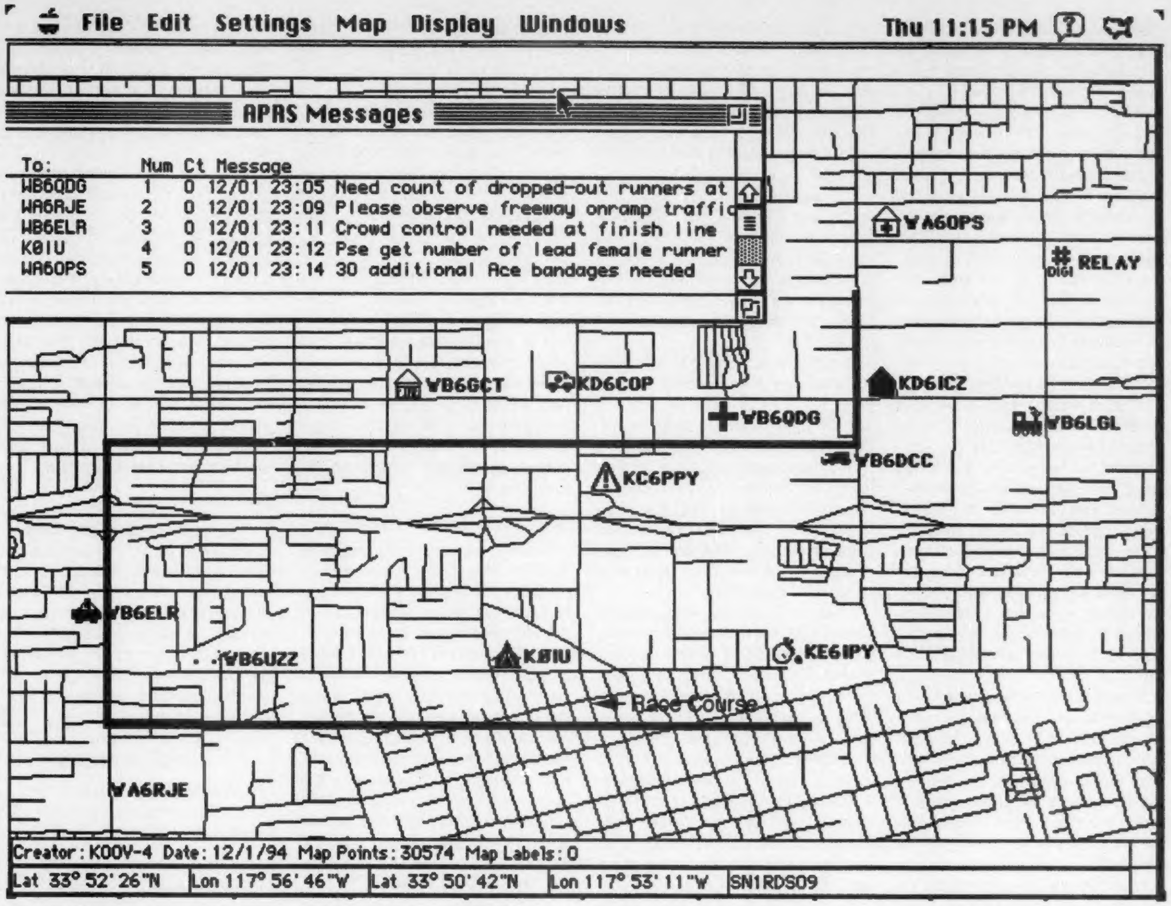


Station List

	Call	CATO
RV OBJ	KC6CCC	R
N OBJ	WIDE	x
OBJ	N6XFC-1	]
BBS OBJ	N6FBH-1	[
OBJ	K6QEH	r
OBJ	N6MN	s
OBJ	WB8ELK	O
OBJ	AA6DD	y
OBJ	W6ORG	X
OBJ	N6ZHZ	j
OBJ	N6MI	k

```
K0OV    (*13) Packets  0  First 12/3/94 11:36:35 PM  Last 12/3/94 11:36:35 PM
Lat 34° 36' 14"N | Lon 118° 16' 05"W | Lat 34° 50' 04"N | Lon 117° 14' 07"W | Dist:  61.3 mi  74°
```

Figure 1. APRS maps RDF bearings, whether entered manually by mouse (the K0OV bearing) or automatically via packet (the WB6UZZ bearing). This is a PC-APRS color map by WB4APR in an 18K file, converted for MacAPRS. Some roads were in colors that did not print on the monochrome LaserWriter.



```
To:          Num Ct Message
WB6QDG        1   0 12/01 23:05 Need count of dropped-out runners at
WA6RJE        2   0 12/01 23:09 Please observe freeway onramp traffic
WB6ELR        3   0 12/01 23:11 Crowd control needed at finish line
K0IU          4   0 12/01 23:12 Pse get number of lead female runner
WA6OPS        5   0 12/01 23:14 30 additional Ace bandages needed
```

```
Creator: K0OV-4 Date: 12/1/94 Map Points: 30574 Map Labels: 0
Lat 33° 52' 26"N   Lon 117° 56' 46"W   Lat 33° 50' 42"N   Lon 117° 53' 11"W   SN1RDS09
```

Figure 2. This race course is on a zoomed-in map made from 1:100,000 USGS CD-ROM data by WU2Z. The extra detail is not needed for a marathon, but it would be very helpful for transmitter hunting. The entire map is a 300K file that runs only on the Macintosh version of APRS.

public service, WB4APR lashes up "breadpan trackers" to put on vehicles. "Take an upside-down breadpan and put your TNC, radio, batteries, and GPS receiver into it," he says. "You can tape it to the roof of a car, or even put it on a bicycle. It's completely stand-alone, sending data but not receiving it."

WB4APR, who just completed his second year of communications for the Marine Marathon, continues, "On a voice net, we can hear where the lead runner is every few minutes, but hams tend to forget, or don't hear and have to keep asking. APRS is a tool to continuously display the first runner, sweep vehicle, and other important stations.

"Our marathon was on a bike trail that crossed roads only at major intersections. At each of those, there had to be a county policeman to stop traffic when the race came through. The police liked to be able to just look at a ham's laptop and see the little dot moving along. They then knew when to go out in the street and stop traffic."

Bob says you don't have to slow down a champion marathoner by putting a breadpan tracker on him or her. "We're not using GPS receivers on the runners or chase vehicles. It's a waste, because their movements are absolutely predictable. The voice chatter lets you know where the lead runner is and APRS fills in the gaps between voice reports.

"When the starting gun goes off, the command post operator tells the computer to put the lead runner object at the start line, sets it in the direction the course is going, and gives it a speed of nine knots. Every 10 minutes or so, he checks. When the dead reckoned spot doesn't make a turn, he hooks it, gives it a new direction, and it dead reckons along that way.

"It's darned accurate. Having done it several times, I know the right velocity to input for the lead runner. If I'm off by one MPH on estimating lead runner speed, it will only be 135 yards off after five minutes. GPS is usually accurate to within 100 yards, due to government-imposed 'selective availability.' So dead reckoning is almost as accurate.

"Instead of runners, we have learned to put GPS on things that have unpredictable routes. For example, 70 ambulances were at the race this year. They came from three states and many jurisdictions, so they had no common frequencies at all. The head Marine Corps doctor dispatched and communicated with the ambulances via amateur radio. The eight ambulances with GPS were the advanced life support units that could end up anywhere during the race. The rest were mostly stationary, so they didn't need GPS."

Good News for Mac Fans

Figure 2 is a mock-up showing the many possible objects that can be mapped on a race course. It also shows off the enhanced graphics capabilities of a new version of APRS for Macintosh computers. MacAPRS was written by Keith Sproul WU2Z, with help from his twin brother Mark KB2ICI.

Keith says he is hooked on Macs, and adds, "I'm a microcomputer manager for a large company. I'm responsible for about 600 Macs and 150 DOS machines. I have six Macs at home on an Ethernet with several gigabytes of hard drive space, two CD-ROM drives on my main machine on one on my ham radio machine, plus a CD-ROM drive on my server and a gigabyte on that. The ham callsign database is on my server and mounts on all the machines all the time."

Whereas WB4APR's APRS for PCs was created in QuickBasic, WU2Z wrote MacAPRS in Think-C. It has completely different code, but is intended to be fully compatible with all of WB4APR's APRS protocols.

MacAPRS takes advantage of the multiple windows, mouse, and pull-down menu environment of the Macintosh. Unlike PC-APRS, there is no map list file to keep updated. When you get a new map, just drag it into the map folder with the mouse. Selecting a map is as simple as pulling down a menu and finding it. With that map displayed, hold down the Option key and click-drag the map area of interest. The program will blow up that region to full window size. You can put aliases of zoomed maps on the map menu for future use.

When you click the mouse on any point on the map, the latitude and longitude of that point are immediately displayed at the bottom of the window. Pressing Command-E brings up a menu so you can put an object on the screen at that point (or you can type in coordinates of another point). This object may also be transmitted to the net.

MacAPRS has a library of about 50 object icons. They can be stationary, moving, (dead reckoned) or give other information such as weather data or

RDF bearings. Once an icon is on the map, you can move it by holding the Command key and dragging it to a new location with the mouse.

When you click and drag the mouse between two locations, a box below the map shows the coordinates of both points. It also shows the exact distance in miles between them and the azimuthal angle from start to finish. When I saw this feature, I realized that it would be a quick way to manually enter RDF bearings on the fly, without having to call up a menu and type them in. I suggested to Keith that he modify the program to add the ability to keep mouse-drawn bearing lines on the screen. "No problem," he said.

When a position report is received via packet, a symbol appears on the screen with a callsign next to it. Click on it and you will see the time it was heard, how many packets have been received from that station, plus the latitude, longitude and grid square in the bottom status line. If you double-click on it, you will get a window with a history file of every packet received from that station. If you have a commercial callsign CD-ROM on line, the program looks up the callsign and displays the data.

In addition to these windows, you can bring up others to show a list of all stations seen, a list of all messages seen, station information, and so forth. With another command, you can exchange one-line messages with any station via unconnected packets. Figure 2 includes a window of typical messages.

MacAPRS includes data bases for Zip codes and grid squares. If you don't know the exact coordinates of a home station, enter its grid square or Zip code and the program will display the approximate coordinates. MacAPRS utilizes existing and future PC-APRS color map files, once they have been converted to MacAPRS format by a program included in the menus. Maps created for MacAPRS only can be larger and more detailed, though, with about 20 times the number of points possible with PC-APRS maps.

If you have the USGS 1:2,000,000 scale map CD-ROM, you can create your own detailed MacAPRS map files. To limit file size and speed up loading, you can include just the features you want. If you don't need railroads or streams, for example, don't convert them.

More detailed 1:100,000 scale USGS maps are also available, showing individual streets. Keith says that in ZIP-compressed form, it takes 14 CDs to hold the entire US at this scale. He is not quite ready to release his program to convert these maps to MacAPRS format yet, but he says he can provide such maps of your town for a small charge. The map in Figure 2 was zoomed from a file made from 1:100,000 USGS data.

"I've had a lot of fun writing the program," Keith says. "I'm working hard to keep up with Bob's APRS improvements. There is a bunch of people running MacAPRS from Florida to Ohio to Texas. I regularly hear from a group in the Chicago area."

MacAPRS requires System 7 to run properly, and cannot be used on older 68000 machines. "It will not run on an SE or a Mac Plus," says WU2Z. "It will run on an LC with 6 megs of RAM, but it starts to lose out with anything smaller. To use the airport and Zip code data bases, you can run it with as much as 8 or 12 megs if you want, or you can selectively turn the data bases off and run with much less. If you have enough memory, you can have several maps open at once, plus the message and station list windows, and you can click rapidly back and forth. Stations in range appear on all maps simultaneously."

MacAPRS and its data bases require 3.3 megabytes in compressed form. If you have a fast modem, look for it on CompuServe and other services. Keith will provide the program on disks for $30 registration fee plus $10 for three HD floppies. "For those who have already registered the PC version with WB4APR and want mine too, the registration fee is only $20," says WU2Z.

Like Bob's program, Keith's is still a work in progress. As of this writing, the latest version (1.0.6) does not yet have all the features of the PC implementation. But once you have registered your first copy, the registration number you get will be usable with future versions.

APRS To The Edge Of Space

Keith is excited about applying APRS to high-altitude balloon experimentation. "A group of Chicago hams held a balloon launch in Minnesota on the weekend before Field Day," he says. "The package had a GPS/APRS beacon. I wrote some extra software for them so that the display would show the ground track of the balloon, plus the elevation at each point. The line on the screen map changes color with altitude. You can tell how the height varies as it moves around the countryside. In the future, their balloons will send temperature, barometric pressure, and humidity, if they can find inexpensive sensors."

Keith is giving high priority to implementing the RDF features of APRS into his Mac version. "I'm the Senior Technical Advisor to a college amateur radio club," he says. "I told them I don't want to do a balloon launch until they have at least two or three foxhunts under their belts. I won't put my thousand dollars worth of equipment up if there isn't a recovery system backup for the GPS telemetry. We need an RDF team that knows what to do."

If you live in the Midwest and would like to learn more about ballooning, GPS and APRS, plan to attend the 28th Mid-Winter Wheaton Hamfest on Sunday, January 29, at the Odeum Exposition Center in Villa Park, Illinois. You can see both versions of APRS and learn about it from WU2Z and from Ed Rogers N9LCI. The Near Space Science group is also holding a conference at the hamfest, including discussions of APRS for tracking high altitude amateur balloons. The 'fest starts at 8 a.m. and should end in time for you to watch the Super Bowl.

Correction

"Homing In" for December 1994 encouraged T-hunters to subscribe to Fox-List, an Internet reflector for RDF enthusiasts sponsored by the Boston Amateur Radio Club. The address for signups incorrectly included a hyphen. Here is the right way to subscribe: Send a one-line message to listserv@netcom.com with the text "subscribe fox-list" (without quotes).

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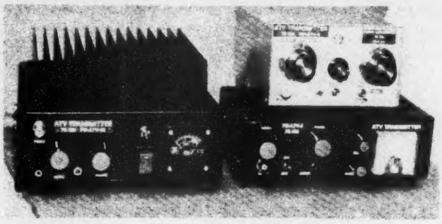

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GaAsFETs and the Radio Amateur: How to Re-Tune Circuitry for Amateur Use

Amplifiers can be constructed out of many different types of devices: from MMIC modular amplifiers, the sort that works in a drawer, from a plastic package, or from various discrete devices. Transistors or bipolar types are the most common devices available in both PNP and NPN varieties.

The transistor is a good device but has a couple of drawbacks when selected for the front end of a high-performance receiver. The primary reason to choose other devices is the noise figure.

The best noise figure is the lowest numerical value you can obtain; 0.76 dB would be a better (lower) value in comparison to 1.5 dB or some other higher numerical value. Best sensitivity is accomplished with the lowest noise figure. That's why a low noise figure front end for a receiver or converter is a sought-after feature.

Now enter the mitigating circumstances, namely frequency. At very low frequencies some bipolar transistors are very good in respect to the noise figure. The 2N3391 family of transistors performs quite well for audio and slightly higher frequencies. As we increase our frequency of operation to, say, 50 MHz, a multiwatt RF power transistor 2N3866 works well. This produced a noise figure of 1.3 dB in a 6 meter preamp I constructed many years ago. Sure, I could have selected other types of devices for this project, but at the time some 12 years ago alternate devices were expensive and static-destructible. I liked the durability of the power transistor and it has performed well to this day. It has even survived some relay switching failures on transmit. I put that device in the pipe wrench class of survivors.

As frequency is increased to around 1,000 MHz, transistors can work well, but the noise figure degrades to a higher value. Special transistor cases are needed to remove bulk capacitance and inductance in the transistor leads to allow effective operation at higher frequencies. The pill case with two emitter leads is a standard configuration. The dual emitter leads decrease lead inductance, making connections very short. This is extremely important at higher frequencies.

Early devices of this type were the MRF-901 and the NEC-021 transistors. Noise figures were in the 2.x dB range. If a better noise figure is desired, a different device would have to be used, namely a Field Effect Transistor (FET). Early FETs were obtained surplus from satellite systems at 4 GHz; they produced noise figures at 1 GHz, near or slightly below 1 dB at 1 GHz. As the frequency increased so did the FET's noise figure but it was several factors below that of a regular transistor. This was typical of the early Dexcel FETs.

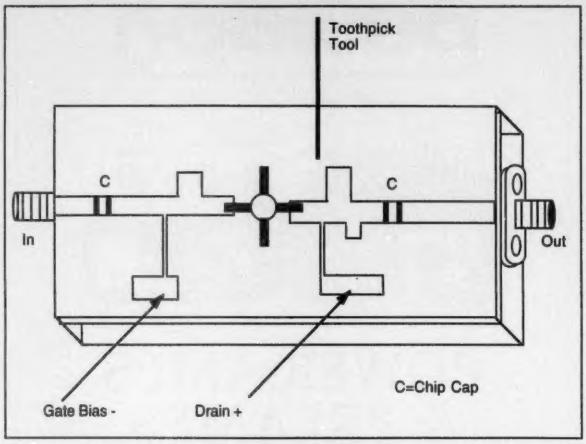

Figure 1. Sample FET amp stage tuning with "toothpick tool."

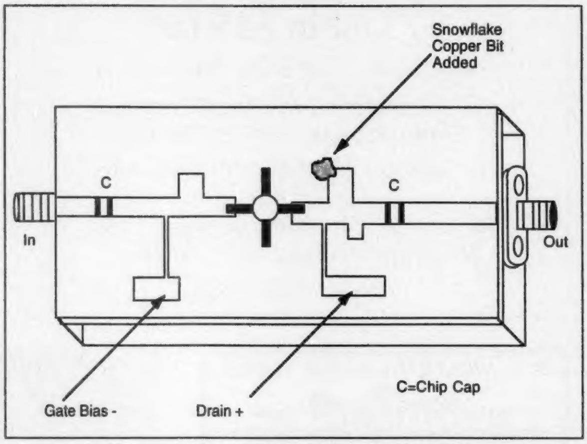

Figure 2. Placing "Snowflake" copper bits on stripline.

Enter modern day FETs. They not only include very high performance (gain) but very low noise figures as well, up into the microwave region to 12 GHz. They are quite usable at lower frequencies and yield very impressive low noise figures at 144 MHz. The same device yielding a 3 dB noise figure and about 10 dB gain at microwave frequencies, produces noise figures of 1 dB or less and higher gains at 2 meters. At lower frequencies stability is a concern however, and precautions should be taken to ensure designs are well-shielded, preventing unwanted oscillations.

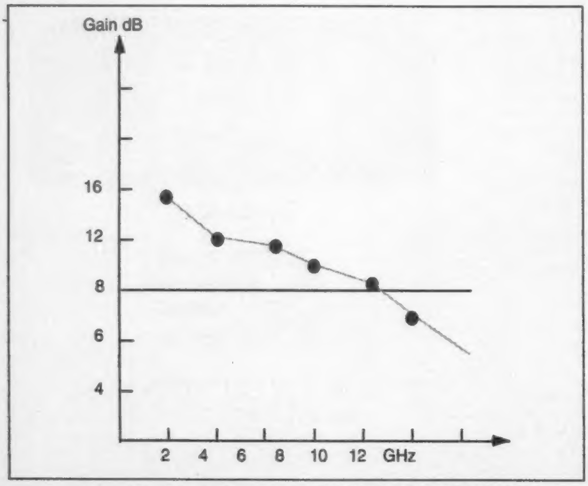

Figure 3. Typical "Gain vs. Frequency" chart for a GaAsFET.

FETs, specifically GaAsFETs, are capable of very high gains and low noise figures from a few hundred MHz to the very high GHz of the microwave region. Some of the newer Hempt GaAsFET devices produce some very good low noise figures and associated higher product costs. Two things seem to have prevented amateurs from using these devices: the cost of the device (which is decreasing as time progresses), and the device's susceptibility to destruction from static electric charges. Considering their cost, some of us do not want to play around with a $10 bill that could go "POOF" when handled improperly.

I avoided working with static-sensitive devices for those very reasons. I could not afford to make a "misteak" as my pocketbook would bleed heavily. Now, after working with expensive devices and even modifying circuitry from commercial applications to amateur frequencies, I have become much more tolerant and confident when working with GaAsFET static-sensitive devices.

There are some basic considerations for working with GaAsFETs in general, but the procedures are the same for all frequencies. From very low frequencies to 10 GHz and above these practices apply evenly. Use them; do not take shortcuts. Above all, think out the procedures described below and you should not have any trouble working with static-sensitive components. The following are some observations for working on circuits using GaAsFETs, made by my partner Kerry N6IZW. The job was to cover not just 10 GHz microstrip retuning but to make it applicable to other frequencies by component scaling. Remember: As frequency is lowered the circuitry becomes larger and easier to modify.

Microstrip Tuning Techniques

This is a description of the basic approach I have used to successfully retune many surplus amplifiers to amateur frequencies. These amplifiers were on frequencies in the commercial bands that would be unusable to amateurs in their original frequency configuration.

J-Pole in your Pocket?

Tough dual-band antenna for the travelin' man or the condo dweller. Hang-anywhere style and extra range can save life in an emergency.

James H. Gray W1XU

During my years of traveling around the eastern United States on business or vacation, I often wished I had a small, inexpensive and easy-to-use antenna to match my little handheld 2 meter radio. Occasionally I had an HF rig in the car, but more often it was the little 2 meter radio which was useful and fun. On long road trips it alleviated boredom, kept me awake and almost always assisted me to find a motel, restaurant, or other ham's QTH. On such trips the mobile antenna was fine until I needed more range from the motel.

When I traveled by plane, the rig was the handheld with no amplifier. It had only a small telescoping whip that I could extend to about 19 inches. If I happened to be close enough to a repeater in a large city, that was fine and I managed to "work" the locals in spite of low power and a minimal antenna.

But there were occasions when there was no local repeater, or when I was inside a steel-and-concrete building. At such times I wasn't able to make any contacts at all and had to resort to dull tedious television programs before going to bed.

If you face similar problems when traveling light and by air, you know how it feels to be alone among the many.

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Antennas West's Pico-J offers some features not found in the usual J-pole. For example, the feedpoint is already found and matched for you, and the antenna is small and light—so much so that it can be rolled up and slipped into a small eyeglasses case. It looks like a sleek black ribbon 55 inches long. A six-foot small-diameter coax feedline comes off the bottom. Its gold-pin BNC attaches directly to your radio.

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A small loop at the top may be slipped over a curtain rod or a nail or any other suitable projection. But, if by chance you don't happen to find a suitable support, Antennas West thoughtfully provides a small suction cup with an embedded hook that can be slapped up on a window or any smooth surface, and presto!—you're on the air!

Pico-J is completely weather-sealed and could be hung outdoors if you wish. Otherwise, you can hang it in a closet or a doorway; in fact, anywhere that is convenient and where your signal won't be blocked. The extra reach provided by this beauty could save life in an emergency, and is always useful when just plain chatting with the locals.

Your Pico-J stretches range, improves reception, reaches far-away repeaters, and saves your battery pack.

The measured VWSR is less than 2:1 between 142 and 150 MHz—ideal for CAP, MARS, and other services near the 2 meter band—and is a very beautiful 1:1 at 146 MHz. Not bad, eh?

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On a recent trip I tucked Pico-J into my briefcase, right next to the handheld. No, I didn't even use the "duckie" or the telescoping whip because I had all I needed in this one neat antenna. Maybe you'll find the same.

*–condensed from **RadioFun***

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General Precautions

Everything must be grounded to power (earth) ground, including the soldering iron tip. The typical FETs in microwave amplifiers will self-destruct with more than 5 to 10 volts on the gate terminal.

Apply only as much input RF power initially as required to get a usable output measurement. This reduces the chance of damage to higher power devices prior to getting the output matched. Also, this prevents saturation of a stage which then appears to not respond to tuning. Applying more than about +10 dBm directly to small FETs may cause damage.

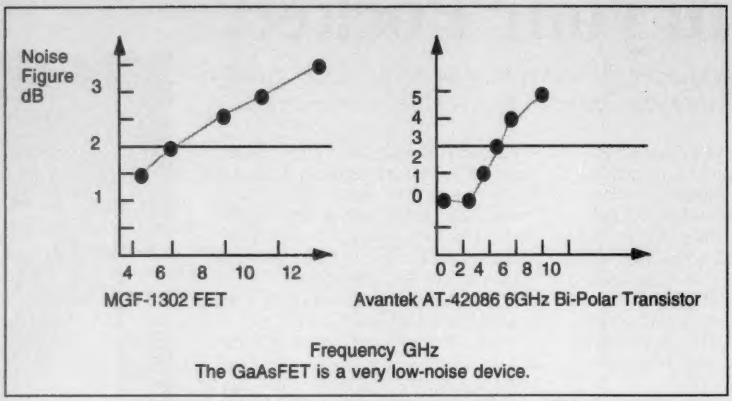

Figure 4. Noise figure comparison: bi-polar transistor vs. FET.

Use current-limited power supplies set to limit slightly above normal expected operating current. In most cases this will prevent blowing up the FETs if the negative gate bias is missing or something is accidentally shorted with the tuning wand. With this approach, sequencing of the power supplies is usually not important.

Place attenuators directly at the input and output of the amplifier. This removes the effect of poor cable, source and power detector matching.

Always remove power when making connections and soldering tuning stubs. Make sure the amplifier output is terminated before applying power.

Tuning Procedures

Prepare the tuning wand and tuning stub material. Cut 1" or 2" strips about 0.080 wide (not critical), or about the same width as the main 50 ohm microstrip lines in the amplifier. Use thin copper or brass stock about 0.003" to 0.010" thick. Tin both sides of the strips and flick off excess solder. Make several wands by cutting one end of a wooden toothpick square at the largest diameter. Using SuperGlue, attach a square copper tab (0.080 by 0.080) of the prepared tinned copper or brass to the cut end of the toothpick. Wipe off excess glue from the exposed side of the square and let the SuperGlue dry.

Remove the existing tuning stubs. Using an X-acto knife, make a deep enough cut to disconnect the existing tuning stubs from the main 50 ohm line. Be careful not to cut the thin bias lines. If you are unsure of possible damage to the bias lines, carefully check continuity, or use a magnifier to do a visual inspection before applying power. In some cases it pays to go through the agony of removing the stub material completely as the correct new stub placement may overlap and cause problems.

Connect the amplifier to the signal source, power detector and power supplies. Turn on the power and adjust the input attenuation for as low an input as can be readily detected on output. Start at output and slide the tuning wand along (in contact with) the main 50 ohm line, watching for an increase in output. Note the maximum output reading obtained with the wand. Remove power and solder a square of the prepared material in the same position as noted by the wand. Do not add solder.

In some cases placing the wand near a certain area of the stripline circuitry decreases rather than increases the power. This is an indication that the existing stub or circuit stripline is excessive. Some of the material should be removed experimentally. Trim the existing stripline in small amounts, say widths about equal to an X-acto knife width. Do not make radical changes here; make small changes to determine the best results. If radical changes are made it may take radical tuning to restore operation.

The tinning is normally sufficient to allow the new tuning stub to be held in place with the pointed end of a toothpick and then just touched with the soldering iron to reflow the solder. Turn on the power and verify that the output is as high or higher than that obtained with the wand. Move the tuning stub if required to obtain results equal to or better than the wand. Slide the wand over the previously attached stub and if improvement can be made, attach another square. Continue this for the entire length of the main 50 ohm line until no further improvement is found. Increase the input power if working with a power amplifier and retune the output stage for maximum power output. BE CAREFUL HERE: DON'T MISMATCH THE OUTPUT SO BADLY WITH THE WAND THAT YOU DAMAGE THE FINAL POWER FET.

The process can be very slow, with some stubs only gaining a fraction of a dB. In most cases it will take all of those small increases to get good results so don't expect to see major improvements with a few stubs. It may take four stubs per stage to get maximum output. Above all, be patient with the circuitry and modifications; go slowly and don't rush any procedure.

Well, those are words to live by when working with GaAsFET devices and PC board circuitry. For me it was difficult to become proficient with these procedures as even with a good pair of reading glasses the circuitry at the 10 GHz microwave bands was not in sharp focus. To solve the problem I purchased a pair of magnifying glass attachments that are worn like a hatband affair, with the magnifying glasses swinging into place in front of the normal reading glasses. I was very impressed as now I could focus on very tiny postage-stamp-sized amplifiers and their circuitry was in excellent focus.

What I hope for in presenting this bit of advice is to promote more construction or circuit modification of existing devices from commercial surplus. As more and more of these devices hit the surplus markets they will find their way to the amateur for use at some band of interest. Whether it be for 432 MHz or 10 GHz operation, these newer FETs, static-sensitive as they are, can be handled without fear of destroying them. Once the devices are in a circuit they become much easier to handle and static-resistant.

In past columns I have provided information on converting 12 GHz LNBs, as well as 3.7 to 4.2 GHz LNAs and LNBs, to broadband operation by modifying the existing circuitry. The procedures described should give you a good handle on what to go through in the modification to mast any circuitry that uses GaAsFETs. We all make errors, but if you don't get in the thick of it and give it a try you will not be rewarded with success. I look at it now as spending a few disposable dollars on a circuit to modify and if it doesn't succeed I have gone to school on this item. It hasn't cost me an arm and a leg but only a few dollars, so no big deal. Start out with a small effort and then work up to larger and larger projects as you gain skills and success.

Good luck on your conversion/modification projects.

Update: LORAN Receivers

The LORAN receiver project was quite popular and our stock of good tested receivers became depleted. The receivers were a surplus item and availability was dependent on providence in the junk department. Well, I am happy to report that we have picked up a small quantity of the LORAN receivers again and have begun testing and the results look very good to a high yield of working boards. The unfortunate part of the story is that the price will have to be increased to cover our increased material costs. The new price for LORAN receiver boards as of 11/15/94 is $35 plus $3 postage, U.S. and Canadian destinations only.

Mailbox

James Duffer WD4AIR queried me on a parametric amplifier U.S. Army AM-6700/TSC. James reports that the name plate does not identify the manufacturer. The amplifier has a microwave waveguide flange input (appears to be 10 GHz) with a type "N" coaxial output. There are two other multi-pin jacks: one labeled "power" and the other "test." If anyone has information on this unit or suggestions for an application for using it contact James at 13203 Staggs Court, Woodbridge VA 22191.

Paul Baxter WA1WJB has picked up a CMC model 901 counter timer and a CMC-931 heterodyne Frequency Converter/Video Amplifier. He picked up both items for $10, although they had $75 price tags on them, at a surplus store that needed to make room for more interesting treasures. Paul is looking for anyone who has a manual for either unit. He has tried calling several of the larger surplus material houses but no luck so far. Can anyone give Paul a helping hand? Contact him at 3425 Terrazzo Trail, Virginia Beach, VA 23452.

Well, that's it for this month. Next month I will start a conversion project using a new surplus CATV front end tuner that we picked up recently. The things that make them attractive are the quantity available and their quality construction. They will serve many different future projects. The list of uses is just starting; for example, they could be used for a VHF spectrum analyzer, or parts of them could be used to form a 1200 MHz ATV receiver.

One feature of these CATV tuners is that they come with an internal frequency divide-by pre-scalar allowing you to determine the frequency of the local oscillator at a frequency divided down to 15 MHz of so. This feature makes many different frequency control functions possible. We'll start to cover some of these aspects on conversion and support circuitry next month.

As always, I will be glad to answer questions concerning this and other related topics. Please send an SASE for a prompt response. 73s Chuck WB6IGP.

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Striking News From PolyPhaser.
May 1994
Volume 3, Number 2
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New Earth Radiation Belt Has Interstellar Matter

NASA's Solar Anomalous and Magnetospheric Particle Explorer (SAMPEX) has confirmed the location of a new belt around the Earth that is composed of different particles than the Earth's two Van Allen belts. Within the inner (lower) Van Allen belt which is mostly composed of protons, the SAMPEX shows a belt of cosmic-ray nuclei composed of so-called anomalous cosmic rays. These rays are the result of solar wind interacting with interstellar atomic nuclei. At roughly 6000 km elevation, at the equator, was the start of the nuclei detection. The density increases with the falling of sunspot activity. The greatest density was above 8000 km over the South Atlantic anomaly. This is where the Earth's tilted magnetic field brings the belts closest to the surface. This is also where there is a high incidence of lightning. This find may lead to a further understanding of the Earth's upper atmosphere which effects our lightning and weather patterns.

Why dc Continuity Protectors, Like Simple Gas Tubes and 1/4 Wave Stubs, Don't Work

The dc type gas tube protector covers a large bandwidth, from dc to
6GHz (higher is possible). Few need this bandwidth, the military being
the exception. Since lightning has most of its energy in the low frequen-
cies below 1 MHz, the equipment connected to such a protector will have
to endure the peak voltages prior to the gas tube's firing as well as the
tube's arcing voltage for the duration of the strike. First, if the connected
equipment has a dc path to ground, the gas tube will never fire. Typically
receivers and cavities are a few of the kinds of equipment with dc paths
across their inputs. In the case of receivers, the shunt to ground is from
a static drain inductor. The incoming surge will follow the dc path to
ground. The equipment will have the strike energy delivered to its chassis
or shell. The only way to get the gas tube to fire is to have a very fast
(nanoseconds) risetime waveform or a very large current (E=L di/dt). The
former is a nuclear event, while the latter is an event which the coil will
likely not survive. Once the coil opens, the current will become a very
high voltage punching through caps and other components. Even if the
gas tube could fire, the arcing voltage would be from 10 to as high as 30
volts. This would be present across the equipment input for 50 microsec-
onds to 500 milliseconds or longer. This is like connecting some batter-
ies across the equipment's input. In the cavity case, the equipment might
be able to handle the current. However, the fact that the surge current en-
ters the equipment room could cause other equipment damage or upset.
The goal of lightning protection is for you to be in control of the strike
current. By spreading the strike's charge into the earth, the energy can be
lowered to survivable levels. In order to do this, the charge must be
spread away from the equipment and prevented from entering the equip-
ment. This cannot be done with a protector which, by design, shares
strike energy with the equipment.
By taking a connectorized 1/4 wave section of coax line and shorting
the center conductor to shield, a 1/4 wave stub can be made. Since the
stub section has a high impedance at the cut frequency, it may be used
with a tee connector as a short across the transmission line. The lower
frequencies of lightning are attenuated. Like an antenna, the stub is a
— continued on page 2

Typical 1/4 wave stub VSWR and loss

Do You Know...

- 1/4λ stub protectors ring with lightning energy?
- which material shields lightning's H field?
- dc continuity RF protectors don't work?
- why single point grounding works best?
- about latent equipment damage?

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More Audio Stages

Last time, we were discussing the troubleshooting of audio amplifier problems in ham gear. Let's finish that up.

Please Be Discrete About This

If the amp is discrete (in other words, it has separate transistors instead of an IC), it usually will employ some form of feedback from the output stage back toward the input stage. The feedback network may go right to the input transistor, or it may be coupled to the stage after that. Either way, blown outputs can sometimes cause all kinds of damage, via the feedback nework, in the input stages. If the network consists of a series-connected resistor and capacitor, chances are the input stages won't get damaged, because the DC blocking action of the cap will prevent disastrous voltages or current flow from reaching the small-signal stages. But, if the network is parallel-coupled, and especially if it uses a low-value resistor, the input stage or stages might be zapped. And, of course, the network itself may become damaged, particularly if it employs an electrolytic or tantalum capacitor, which might then leak enough current to damage the input stages.

When changing output transistors, always be sure to carefully check any emitter resistors for cracks and opens. When the outputs short out, they try to pull full power supply current through those resistors, causing them to get mighty hot. Sometimes, tiny cracks in the resistors form and cause an open, stopping the current. Then, when the parts cool down again, there's enough physical contact for the resistors to sort of work again. I say "sort of" because the resistance value may go up and down, and the whole part may intermittently go open (arrrgh!!), both randomly and with temperature.

In high-power, hi-fidelity amps, many push-pull designs have biasing potentiometers, because it is important to set the bias very carefully for lowest distortion consistent with efficient operation. If the bias is set too high, the idle current goes way up, and the output transistor will run way too hot. If it's too low, though, crossover distortion increases to an unacceptable level. In smaller, lower-fi amps like you find in ham gear, nobody's worrying too much about crossover distortion, so the bias resistors are just about always fixed; you don't have to worry about that issue. But, there may be some diodes used to set the amount of current flowing through the bias network, so be sure to check them. After all, you often don't know what really blew the amp in the first place, and a serious increase in DC bias could have been the culprit.

. . . Kinda

So, you found some bad output transistors, or perhaps a blown audio amp IC, and you changed it. And, it works! Well, kinda. You have audio, but it's distorted or you can't get reasonable volume. Obviously, something else is still wrong. But what? Well, go back and check the squelch gate transistor, like we discussed last time. If there's plenty of power getting to the amp, try replacing the output capacitor, if there is one, paying careful attention to the cap's polarity. As a last resort, disconnect the audio line coming from the demodulator and try feeding it to another amp of some kind. If you don't have a small service amp on your bench, you can, in a pinch, feed the signal into the microphone input of a cassette recorder, as long as you use a resistor network first and cut the level down by about a factor of 100 or more. If the audio still sounds like it has the same problem as it does through the radio's amp, your trouble is somewhere else! All kinds of demodulator problems, including a mistuned discriminator coil, can cause audio distortion severe enough that it sounds like you have amp trouble. Heck, I remember one hamfest-special HT I worked on that always sounded distorted enough that it could have been off-frequency by 5 kHz. It drove me nuts until I discovered that someone had replaced the second local oscillator crystal with a 10.245 MHz rock, when the original had been at 10.240. So, it really *was* 5 kHz off, and the resulting distortion would have been very easy to have mistaken for an audio problem. It pays to do your sleuthing carefully, before you order parts or tear up the PC board.

> ***"I have seen a few cases where RF feedback was so strong that it actually damaged something in the mike amp circuit, but it's quite rare. It is possible to cause damage, though, by feeding very high audio levels, perhaps from another piece of gear, into the microphone input."***

The Other Side

At the other end of the audio chain is the microphone amplifier. Because the signals are so small, mike amps don't often blow up. But, other problems can arise. The most common in HF gear is RF feedback. The sound of RF getting into your mike circuit is distinctive enough that, once you've heard it, you probably will never forget it. But, different antenna, ground and microphone installations can produce variations on the theme that range from out-and-out squealing to bubbling noises to distortions which occur only on voice peaks. And, if you use any kind of speech processing, the mess gets magnified tremendously, thanks to the processors' compression effect. So, before you dig into a mike amp problem, it's worth seeing if the real culprit is RF feedback, which it often is. The easiest way to do that is to run the rig into a dummy load. If you don't have one, try turning the RF output power control way down. With the many rigs that don't have output controls for SSB, you just turn the mike gain control very low. And always be sure to turn off any speech processing. Of course, for any of these methods, you'll need to monitor the signal with a separate receiver, unless the rig has a built-in IF monitor function. If the garbage goes away, RF is causing the trouble. If it's still there, the mike amp circuitry may indeed be broken. To be sure, try operating on another band; a bad mike circuit will cause the same audio mess on any band, while a feedback problem usually changes from band to band. Also, try another microphone; old ones, especially of the crystal or ceramic variety, can go bad with age.

I have seen a few cases where RF feedback was so strong that it actually damaged something in the mike amp circuit, but it's quite rare. It is possible to cause damage, though, by feeding very high audio levels, perhaps from another piece of gear, into the microphone input. Whatever the reason, let's say you find that the mike circuit needs service. Now what?

Well, that depends on the kind of radio you're servicing. If it's a multimode, the mike circuit may include speech processing and vox circuitry. If it's an FM rig, some kind of automatic gain control (AGC) or volume limiting is probably included. And, of course, the destination of any microphone input circuit is a modulator; are you sure the real trouble isn't there?

Running Aground

When is a ground not a ground? When it's a mike ground! Many HF rigs use a separate ground for the microphone. Although it is ultimately connected to the other grounds, it comes directly from the microphone input on the mike amp board, and typically only the shield of the mike cable is connected to it. This arrangement goes a long way toward reducing RF feedback problems. Some mikes, though, don't have separate grounds, they tie the PTT ground and the mike shield ground together. That often spells feedback disaster. Before you go digging into the mike circuit, be sure your grounds are configured as specified in the manual. Not all mikes are ideal for all radios, and you may have to modify your mike to work with a separated-ground system. Also, some preamplified microphones are particularly susceptible to RF troubles, and nothing seems to clear them up except replacement with a non-preamped mike.

If you're sure you don't have a feedback problem, try turning your speech processor on and off. If the trouble comes and goes,the processor may be at fault. Then again, it may just be worsening some other bad stage's effects. Often, the gain increase that comes with processing can make everything, from feedback to bad circuits, seem much worse. I suspect many a fruitless hour has been spent poking around in perfectly good speech processors, when the real problem was nowhere near that circuit.

Mike circuits are best troubleshot with an oscilloscope. That way, you can see where the signal stops or becomes grossly distorted. If the signal looks good on the line going to the modulator, though, the mike circuit must be working properly. What about the modulator itself? If your rig has both SSB and FM, try transmitting on both modes, preferably into a dummy load. Unlike SSB and AM, FM uses an entirely separate modulator. So, if they both sound messed up, the trouble can't be in the modulator.

One common problem is overly bassy or tinny sound on one sideband. That is *not* an audio issue. It's caused by misalignment of the carrier frequencies, which determine the passband of the resulting RF after it passes through the sideband filter. When you change from one sideband to the other, the modulated double sideband signal appears inverted to the filter. In other words, the signals representing high and low voice frequencies switch sides within the filter's passband. No sideband filter is perfectly symmetrical, so it's pretty common for there to be some difference in audio frequency response between sidebands, but it shouldn't be much. When the carriers are off, though, part of the desired signal can get cut off, because it's outside the filter's passband, and some bass or treble voice frequencies get lost.

Well, I think we've about covered audio issues. Next time, something completely different! Until then, 73 de KB1UM.

NEVER SAY DIE

Continued from page 4

14,313, and on a few chosen repeaters. This is a hobby! It's supposed to be fun! We have a ton of fun things you can do, so the next time I give a talk, I want to see some damned hands go up when I ask if you've been active on our satellites, or been on a DXpedition somewhere. I want to see hands for RTTY, even more packet hands, slow-scan, 6 meters, aurora DXing . . . . and elmering. I want to see those hands waving when I ask if you've given a talk at your local school on the fun of amateur radio.

If you've got a computer why aren't you helping your club have a better-looking newsletter? Some are wonderful, but others are real crud. Tsk. All it takes is a Mac with Word, a laser printer, and you're in business. The next step is to find out if anyone in the club is doing anything interesting and if so, write about it. Someone must be involved with something more than saying nothing at length over the repeater.

Now where did I put that REPENT! sign?

Oh yes, if you have any friends who are building interesting things or inventing new antennas, the chances are they aren't writers, so write about what they've done and give me a chance to publish it in *73* or *Radio Fun.*

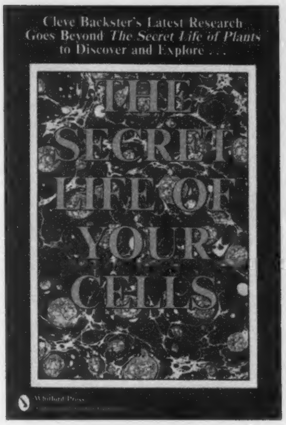
Commercial Break

If you have any friends who are interested in making a recording in a studio designed specially for digital recording, I can show them some fan letters from people who've heard our incredible Scott Kirby CDs. These were recorded at the studio at my farm in Hancock, and there's nothing else like it, as far as I know.

And, if you run out of things to talk about on the air, you could do worse than send $20 (postpaid) for my 360-page book and 320-pages of *Updates* (while they last). They're packed with practical proposals for solving our more serious social problems. Like crime, drugs, crowded prisons, welfare, the deficit, foreign aid, health care, our terrible educational system . . . stuff like that.

If you think it costs a bundle to go on a DXpedition you need to invest a measily $7.50 for 96 pages of *Uncle Wayne's Caribbean Adventures,* where I visit hams, DX, and scuba dive my way through the islands. Or perhaps you'll benefit from seeing how Uncle Wayne deals with Russia, the Crimea, St. Pierre, Krakow, Vienna, Prague, Munich, Aspen and London? $5 for 52 pages.

Then there's *Uncle Wayne's WWII Submarine Adventures.* Five war patrols, 60 pages for $7.50. The prices are all postpaid. For anything else from Uncle Wayne, like books and code tapes, there's a $4 packing and shipping fee per order. That's where we make all our money.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THE SECRET LIFE OF YOUR CELLS
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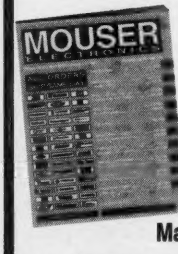
If I can get some help running the magazines I'll finish editing the story of my African hunting safari, complete with visits to hams all around the world . . . Italy, Greece, Kenya, Uganda, Tanzania, Sudan, Ethiopia, Eritrea, Egypt, Lebanon, Syria, Iraq, Iran, Afghanistan, India, Nepal, Burma, Thailand, Singapore, Australia, New Zealand, New Caledonia, Fiji, Western Samoa, American Samoa, and Tahiti.

Well, you see, Robbie 5Z4ERR kept pushing me to come over and visit him in Nairobi. So while I'm there, why not do some hunting, right? I found a book by Herter on how to go on an African hunting safari for $690. That clinched it. Two other hams I talked into it through my editorials and I really did go on a $690 safari and I shot all kinds of game, including a near record water buffalo, eland, oryx, and so on. It's a heck of a story . . . especially when we came that close to getting killed by some Somali tribesmen in the Rift Valley desert of northern Kenya up by Ndoldol.

Another Great Book!

In between reading books on quantum mechanics, I've also been sneaking in some books on biocommunications. I've already recommended the wonderful book, *The Secret Life of Plants,* and the second book reporting on Cleve Backster's work, *The Secret Life of Your Cells.* In those I learned about the research that's been done showing how people and plants can communicate and how your cells stay in communication with each other, even when separated by thousands of miles from you.

Now I've come across an incredible book by J. Allen Boone, *Kinship With All Life.* Here I found out that people can communicate, mind-to-mind, with animals, reptiles, and even insects such as ants and flies. This ties in with many other books I've read about people who have been able to talk with animals, but never before have I found



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a how-to-do-it manual.

At first I thought that this book would be particularly difficult for skeptics to deal with. Then I realized that this isn't a problem at all . . . because they would never even bother to read it. That's the best way to maintain a skeptical ignorance.

Kinship was published by Harper San Francisco, $9, 157 pages, 1976. ISBN 0-6-060912-5. Get a copy and read about Freddie the fly and Strongheart, the actor-dog. I'll get you to thinking about the difference between life and inanimate matter yet.

There was an interesting article in the July 1994 *Scientific American* on consciousness. I was glad to see that I'm not the only one concerned with trying to understand what life is. In the article Colin McGinn argues that the relation between mind and matter, consciousness, will remain forever beyond human understanding . . . just as rats or monkeys will never understand quantum mechanics. So far the lack of understanding seems more due to a lack of research than an ability to understand.

It's Always Something

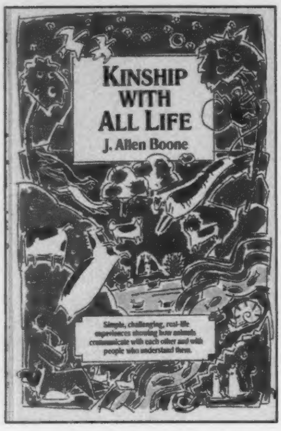
Yes, of course I'm spread too thin. Just running *73* is more than enough for one person to manage. Heck, I did it full-time for years. Real full-time . . . . like 100-hour weeks. And that was with a staff of eight to a dozen people handling the ad sales, editing articles, doing the typesetting, proofing, artwork, page layout and paste-up, subscription efforts, newsstand sales, bulk sales to ham stores, bookkeeping, dealing with columnists, testing new equipment, running booths at hamfests, customer service, dealing with the post office, and so on. I even used to have some time to get on the air.

With *Radio Fun* it's the same thing, although there is a good deal of overlap, with the *73* team doing much of the work.

But then my publishing *CD Review* got me involved in the music business. Very involved. Having been a music lover from my early teens, and into hi-fi manufacturing 40 years ago, it seemed to me that a magazine devoted to promoting compact discs might help this amazing new digital format be accepted. It did, and the magazine quickly became the leading music review publication in the country.

That got me into starting my own record label so I could record the incredible ragtime performer, Scott Kirby. I think that's helped too. When I started doing that there was only one ragtime festival in the country, in Sedalia, Missouri. Now there are over 20, and they're spreading to Europe with ragtime festivals in France and Hungary. And Scott Kirby, who has brought a whole new meaning to ragtime, is the featured performer at most of these!

In order to make better recordings of Scott I built a state-of-the-art recording studio. That's fine, except that once I did that I had to advertise it, get a sales person to make calls and send out literature, have an engineer, book in acts, and so on. That takes a staff.


KINSHIP WITH ALL LIFE
J. Allen Boone
Simple, challenging, real-life experiences showing how animals communicate with each other and with people who understand them.

Making the CDs requires writing the liner notes, taking the cover photos, setting the type, doing the layouts, printing them and the tray cards, doing the artwork for the disc, mastering the studio digital audio tape (DAT) recording, and then having the CDs pressed, put in jewel boxes with the liner notes and tray card, and shrink wrapped. The cassettes have to have J-cards designed and printed, and the cassettes duplicated and shrink-wrapped.

It's useless to just make CDs and cassettes if you don't sell them. That means ads in magazines, promotion to newspapers, magazines, and radio stations, a sales staff, a warehouse for inventory, packing/shipping personnel, and a couple of bookkeepers. More staff to hire and manage.

Since most CDs are sold through record stores I needed a way to reach them. I found there was no publication aimed at the 10,000 record stores, so I started *Music Retailing* as a way to get the word out about my CD releases, plus any other record companies I could get to advertise. We also ran ads from accessory companies, store fixtures, sales systems, security systems, and so on.

The more CDs you have made, the lower the price, like anything else. So I started soliciting manufacturing orders from other small record companies to build up our volume. That meant more ads, sales literature (which had to be written and printed), a sales staff, and more staff to do the liner notes and tray cards, to help with the jewel box stuffing and shrink wrapping, and so on. More staff, more problems, more bookkeeping, more legal work dealing with the music copyrights. One song that a customer lied about on our copyright release form cost us nearly $40,000 in legal fees! And soon we were manufacturing CDs for over a thousand small independent record companies, with each CD having 10-20 songs. What a legal nightmare!

To help these independent record companies sell their music I started a CD sampler program. The one thing that sells music best is hearing it. Unfortunately, the indies are unable to get much radio airplay. The six major record companies (five of which are foreign-owned), pay nearly a hundred million dollars a year to make darned sure radio station music directors play only their music. So I started putting together sampler CDs, each with around 15 tracks of one type of music, as a way to help indie sales. We've produced over 125 of these so far and distributed from five to 15 thousand of each free . . . except for a $3.79 shipping and handling charge.

We paid for the manufacturing of the samplers by selling the sampled indie CDs by mail order. When they are manufactured the factories always make a few extra. We made a deal to keep these and sell them to pay for putting one of their tracks on a sampler.

Our efforts seem to be paying off because the market share for independent music has gone from 4% to 15% in the last five years. That's over a billion dollars more in added sales.

To help bring in more manufacturing contracts I started sending a monthly publication to about 15,000 independent labels . . . *The IMPS Journal*.

This kept more people busy editing, selling the ads, doing the typesetting and proofing, handing the circulation, bookkeeping, and so on.

In all I had a complex of intertwined divisions geared to produce ham magazines and sell independent music. The only possible way for me to cope with two ham magazines, Uncle Wayne's Bookshelf, the music publications, a mail order music company, a recording studio, a record company, a CD brokering business, distributing indie CDs to record stores, the sampler CDs, my "Speak N'hamsha" tape, a videotape on sales promotion, marketing my *Declare War* book, and so on, was to have an administrative staff and depend on them. Any one project I could handle, sure, but over a dozen of them?

So I had a financial officer to handle both the company and my personal financials. A general manager kept track of the division managers. All I had to do was attend weekly management meetings to see how things were going and look over the financial reports. When any problems came up I'd see what I could do to help.

Most of my time was taken up with giving talks at music conferences and hamfests, working with the New Hampshire Economic Development Commission, writing lengthy reports to the Commission, working on the local hospital board, and taking off now and then on combined ham radio DXing and scuba diving trips. My homework for the Commission involved subcommittee meetings several times a week, an hour's drive away in Concord, plus reading over 200 books. So I managed to keep fairly busy. Oh yes, I also wrote my usual short editorials for five publications a month.

Oops, make that six editorials. I almost forgot about *"Cold Fusion."* I took off a few days last December to attend a cold fusion conference on Maui. Last spring I staffed and started the magazine. Then last summer I found tha the company financial situation was a mess. I discovered we'd been getting fudged financials at our meetings and that we owed the IRS a bundle.

Having had a disastrous hassle with the IRS some 20 years ago, even though I'd done nothing wrong, I was incredibly sensitive on the subject, so I almost got upset when I found out what was going on. I was even further edged toward being upset when I found that all of my personal stocks had been sold, my bank accounts emptied, and my credit cards were at their limits.

It turned out that there was a plan to put Wayne out of business, with one group taking over the music publications, another the CD manufacturing, one the ham magazines, and the fourth wanted the cold fusion magazine.

When I discovered all this I cleaned out over a dozen people and took over myself as chief financial officer, general manager, and the editor of *73, Radio Fun* and *"Cold Fusion."* I put the music publications on hold and cut the cold fusion magazine back in pages so it would be in the black. The glossy magazine was costing us around $50,000 a month more than a simpler publication with me as the editor, so that had to be changed. I hated to do it, particularly when I learned that our third issue had won the coveted *Folio* Ozzie award for the best designed new technical magazine of 1994 and that we'd been getting a record 76% newsstand sale (40% is considered outstanding). And this despite a $10 cover price, which some worry-warts said would keep it from selling.

The September issue was the first in the new format, and it was very well received by the subscribers. Only two refunds were requested, and there were lots of letters saying how good the new publication looked and how full of information it was.

I won't cry on your shoulder about the missing articles the ex-editor took with him, the stolen mailing lists, and things like that. But it was a mess and the three teams of lawyers involved will end up doing very well by the time all this is over. We're still trying to find where a couple of million dollars went.

So how are things going? Amazingly well, considering. The back IRS bill has been paid, and the penalties and interest will be paid off in a few weeks. The ham magazines, Uncle Wayne's Bookshelf, *"Cold Fusion,"* and the CD manufacturing operations are operating in the black, and we're paying off our debts as fast as we can.

What really hurt was when a pinko ham newsletter interviewed some ex-employes who were at the root of our troubles and printed their lies. Several advertisers, on the basis of these lies, cancelled their ads, which could cost us thousands of dollars. And who knows how many hams might decide not to subscribe as a result? One ham news reporter said the word going around was that there was a plot between one of my employees and a certain ham publisher to have the IRS put us out of business and then grab *73* for a song when the IRS auctioned it off.

I can run the business just fine when I have to, but I prefer to develop magazines to help new technologies grow, to tackle our major social problems, and have a little time for hamming, skiing and scuba diving. Heck, I've worked hard for a lifetime and in my 73rd year maybe deserve a little slack.

Of course probably my biggest problem is that I've never had any interest in making money, so when I've lucked into it I've always let other people take care of it. Managing money is a full-time job, and it's not my idea of fun. I'm getting my Social Security checks now, and that's more than enough for what I need personally.

I'm working to build the *73* and *"Cold Fusion"* circulations. No one who's keeping up with the research in the field doubts that we'll have cold fusion powered homes and cars in just a few years. And probably watches, airliners, and everything else. I expect watches and small communicators will be powered by cold fusion cells made up of a few molecules thick alternating layers of titanium and deuterium. They'll run forever. Well, we'll see.

The coup at *73* failed, the bad guys are out, and we're a smaller, fighting team. We're making money and paying our back bills. I hope my friends will help me by getting more subscribers, and maybe even lean on some of the advertisers to come into our magazines, or increase their ads.

By the way, the same prize-winning production person who won the Ozzie for *"Cold Fusion"* does *73!* That's Linda Drew, who's been with me for 16 years now and works magic with our Macintosh publishing system.

Another little project that's taken a good deal of my time has been promoting the AIDS cure which was discovered by the Albert Einstein College of Medicine (they even have a patent on the process). This approach sounded logical to me and didn't seem to have any potential for doing damage, so I put together an instruction pamphlet on how to build the very simple device involved. I've sent the pamphlet free to anyone who asked, guaranteeing nothing. It's an experimental approach which doctors should be testing.

Since then many people have rid themselves of AIDS using this device. Amazingly enough, I haven't heard of any failures! The unit also seems to wipe our hepatitis and herpes viruses. But most astounding of all, a good friend who had no HIV or AIDS tested the device on himself, zapping his legs for a couple hours instead of a few minutes, just to make sure no harm could come from the procedure. What happened was that this apparently wiped out a lifetime of accumulated parasites in his blood and reset his appestat, with the result that he started losing weight . . . even though he continued to eat normally. He's lost 65# so far, and his wife, who knew a good thing when she saw it, quickly went from a plump 145# to a thin 120#, where she hadn't been since she was 17. This sounds like great way to get back to one's normal weight. When I think of how hard I had to diet to take off 100 pounds!

OK, I'm exaggerating. Sort of. I dieted for about seven months 20 years ago and took off 85#. And kept it off! Recently I decided to drop another 15#, and I've done it. But that's meant doing without ice cream, bialys and other goodies. I'll have to give the zapper a try and see if I can lose some more and still be able to eat ice cream and bialys whenever I want.

> ***"The coup at 73 failed, the bad guys are out, and we're a smaller, fighting team."***

Let's see now, how many millions does it cost to get FDA approval on something like this? And how many years does it take? Ugh. I doubt I'll live that long.

What's a bialy? Tsk. Bialys, short for bialystokers (named after a city in Poland), are a kind of bagel. They are terribly addictive, so don't try even one. You slice them in half the long way and give 'em a 20-second zap in the microwave to return them like fresh out of the oven condition, a little dab of butter, and mmmm. Wow, are they good! One of the local supermarket chains (Shaws) brings 'em in frozen and sells 'em, but very few people have discovered how good they are. They're made with a high gluten flour, so they're chewy, and they're sprinkled with onion.

They're also fabulous toasted, and you can keep 'em in the freezer. About 30 seconds in the microwave thaws 'em out so you can cut 'em in half.

There are a lot of things I should be doing, if I had the time. Like making up ads to help sell our crummy warehouse full of CDs. Like promoting my *Declare War* book. Like promoting our "Speak N'hamsha" tape to the New Hampshire gift shops. It's a wonderfully funny tape narrated by Fritz Wetherbee. This tape helped Fritz become a fixture on Channel 11 with his New Hampshire Crossroads program.

Most of all I'd like to try doing a daily talk radio program and syndicating it. I'd like to help people discover some wonderful music they've probably missed, books, poetry, cooking, get 'em hooked on amateur radio, and so on. I'd also like to get 'em interested in actively changing welfare, our prison system, and a few other critical social changes that are needed.

None of the mess has affected *73* very much, but *Radio Fun* came close to being put out of business. They got it way behind schedule, angering the readers and annoying the advertisers. By the time you read this it should be back on schedule, doing its job of providing inspiration to every newcomer to the hobby, encouraging them to try the many wonderful aspects of hamming.

Say, you could do worse than enter a $25 combo subscription for *73* and *Radio Fun* for your local library, and for your nearby school libraries. If the kids aren't able to read about hamming, it's going to be tough to get 'em interested. And without a raft of new blood coming into the hobby, we could easily lose the whole works.

The main purpose of *Radio Fun* is to help hams get involved with more than rag-chewing . . . to get 'em started on packet, satellites, and so on. It even pushes the fun of CW . . . which can be a ball, once the code comes easily . . . and all that takes is a few hours of practice with computer generated code, or with good ol' Uncle Wayne's Bookshelf code tapes.

Your Property Confiscated!

What would be your reaction if your state government were to decide to take your house and property from you with no compensation and then agree to let you keep using it only if you paid them rent? And if you have a business, they'd also take your building and land, still with no compensation, and let you keep using it only if you paid rent?

Think about it. Would that be enough to make you mad? Would it be enough to get you to want to actually do something to fight back?

Well, if you think about it, that's exactly the situation if your state has a property tax. The fact is that you don't really own your property. If you fail to pay the rent (tax), the state will take it away from you and auction it off to pay your unpaid rent. The purchaser won't actually own it either, just being the new renter.

Solutions Wanted

An eon or two ago I worked at a research foundation run by a chap who eventually became a multi-billionaire. On his office door was a sign: "Bring me solutions, not problems." I've always liked that concept, and that's the way I tend to look at things. A problem provides an opportunity to come up with a creative solution.

In the ham field we have a ton of problems, complete with endless on-the-air kvetching about them. What I seldom hear offered are proposed solutions. Just gripes. Hey, wake up and smell the garbage! So here's a challenge, if you're up to it. Take one aspect of amateur radio where there are problems which you find annoying (or worse) and see what you can come up with in the way of a creative proposed solution.

Let's take repeaters for instance. What's aggravating you about repeaters? What isn't? Have you got an old buzzard roosting on your repeater who has nothing to say and all day every day to say it? Or maybe you've got some cretins with a couth shortage who are fouling the air? Or maybe a kerchunker? Or some freeloaders? Or, on the other hand, an officious control op?

Instead of making yourself part of the problem with endless on-the-air complaints, how about giving what little of your mind that's left after being battered to an almost useless pulp learning the code a chance for some creativity? There are solutions to *any* problems. Step two is to figure out how best to implement your solution.

While I'd prefer you come to me with a success story of the problem, your proposed solution, and how you went about the implementation, I don't want any good ideas to die for the lack of initiative on your part. If you are too weak in the wooper to get results first and then write it up, at least write an article I can publish to help spark some other more alive hams into using your creativity for the benefit of our government sanctioned old white man's hobby.

If you're into contests, don't tell me you can't think of any improvements that could be made. Contests are the ham manifestation of male competiveness and the need to show who has the biggest . . . er . . . signal. I've had a great time with DX, VHF, and Sweepstakes contests. Of course, if I were going to do one again, I'd use a voice repeater to keep from having to call "CQ contest." Then how about another chip to give the repeatable part of the contest contact? That could be complete with voicing a incremented contest number.

Then there's the little problem of not being able to listen while you're transmitting. Hmmm. That's easy. All you need is two locations for your station, one for transmitting, maybe five miles away from your receiving site, with a 10 GHz control link to turn the beam and tune the VFO. No strain. We'll have your name up high on a list of almost-winners in *QST* or *CQ* yet. Just think how impressed the dozens of readers who bother to look at contest results will be to see your call listed! Wow!

Make a list of the problems that have been vexing you in your ham niche and let's see what creative solutions you have to offer. I'm waiting. The readers are waiting. Get off your duff, word process an article and send me the hard copy and a disk.

Number 78 on your Feedback card

SPECIAL EVENTS

Ham Doings Around the World

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the February issue, we should receive it by October 31. Provide a clear, concise summary of the essential details about your Special Event.

JAN 29

ODENTON, MD A Post Holiday Swapfest will be held at Odenton Vol. Fire Dept. Hall, 1425 Annapolis Rd., 8 AM-2 PM. VE Exams; pre-register with *Jerry Gavin NU3D, 7801 Overhill Rd., Glen Burnie MD 21060; Tel. (410) 761-1423, anytime*. Talk-in on 146.205/.805. For tables, contact *Tom Wilkison KA3OMU, 592 Eason Dr., Severn MD 21144. Tel. (410) 969-2639, eves*. Sponsored by The Maryland Mobileers ARC.

WHEATON, IL The Wheaton Comm. Radio Amateurs will hold their 28th Mid Winter Hamfest from 8 AM-3 PM at the Odeum Exposition Center in Villa Park IL. Call *(708) 545-9950* for general info. Talk-in on 144.790/145.390 MHz and 222.540/224.140 MHz. Commercial vendors pleas call or FAX *(708) 545-9950*.

FEB 4

ST. CATHARINES, ONT., CANADA The Niagra Peninsula ARC will hold their Big Event #17 Flea Market from 9 AM-2 PM at the C.A.W. Hall, 124 Bunting Rd. Talk-in on 147.24/.84. Contact *Marg Sewell VE3HOX, (905) 680-1211*. Advance payments can be sent to *NPARC, P.O. Box 20036, Grantham Postal Outlet, St. Catharines, Ont. L2M 7W7, Canada*.

FEB 5

LORAIN, OH The Northern Ohio ARS will hold its Winterfest 1995 at Gargus Hall, 1969 N. Ridge Rd. Doors open 8 AM-1 PM; Setup at 7 AM. Flea Market and Commercial booths. For tables, contact *Dee Dee Ohman KA8VTS, 4122 Bush Ave., Cleveland OH 44109. Tel. (216) 398-8858*.

FEB 11

CHARLESTON, SC The 22nd Charleston Hamfest and Computer Show will be held 8:30 AM-4 PM at Charlestown Landing State Park, under the dome, just off Hwy. 171. Tell the person at the gate you are with the Hamfest and there will be no charge to get in the park. Talk-in on 147.18(+), 146.835(-), 147.27(+), 146.76(-), 147.30(+), 443.8(+), and 444.3(+). VE Exams will be given at Noon at St. Andrews H.S. on Wappoo Rd. Bring original and copy of your license, and any CSCE's you have, two ID's, one with a photo. Walk-in only; contact *Ed KC4OOZ, (803) 871-4368*; or *Gary AC4PL, (803) 766-3440*. Send advance payments to *Jenny Myers WA4NGV, 2630 Dellwood Ave., Charleston SC 29405-6814. Tel. (803) 747-2324*. Make checks payable to *"C.A.R.S. Hamfest Committee."*

FEB 12

FREEPORT, NY The Long Island Mobile ARC will host a Hamfest at Freeport Armory, 63 Babylon Tmpk., 9 AM-3 PM. VHF Tune-up Clinic. Talk-in on 146.25/.85. Contact *Neil Hartman WE2V, (516) 462-5549*.

MANSFIELD, OH The Mansfield Mid-Winter Hamfest/Computer Show will be held at the Richland County Fairgrounds in Mansfield, starting at 7 AM. Talk-in on 146.34/.94 W8WE. For info, tables, etc. send SASE to *Pat Ackerman N8YOB, 63 N. Illinois Ave., Mansfield OH 44905*; or phone *(419) 589-7133 after 4 PM EST*.

FEB 18

HORSEHEADS, NY The ARA of the Southern Tier will present a Hamfest at the NY State Armory, 128 Colonial Dr. Indoor Flea Market. New Equipment Displays. VE Exams start at 9 AM. Flea Market tables available on a first come basis. Doors open 7 AM-3 PM. Contact *Jack Slocum, (607) 739-4866*.

SALEM, OR The Salem Repeater Assn. and Oregon Coast Emergency Repeater Inc. will co-sponsor the 1995 Salem HamFair at the Polk County Fairgrounds in Rickreal OR. Time: 9 AM-4 PM. Set up 6 PM-9 PM Fri. night and 7 AM Sat. morning. Talk-in on the 146.86 Rptr. Contact *Evan Burroughs N7IFJ, (503) 585-5924*.

TRAVERSE CITY, MI The Cherryland ARC 22nd Annual Swap-N-Shop will be held 8 AM-Noon at the Immaculate Conception Middle School. VE Exams at 1 PM, walk-ins accepted. Talk-in on 146.860. Contact *Chuck Mellberg W8SGR, (616) 946-5312*.

FEB 19

DAVENPORT, IA The 24th annual Davenport (Iowa) ARC Hamfest will be at the QCCA Expo Center in Rock Island IL. Flea Market. Commercial Exhibits. Talk-in on the W0BXR 146.28/.88 Rptr. For reservations or details, send an SASE to *Kent Williams K9UQI, 4245 10th St., East Moline IL 61244*. For VE Exam info, send an SASE to *Roger Franke K9AYK, 2506 E. 29th Ct., Davenport IA 52803*.

VANCOUVER, BC, CANADA The Burnaby ARC will host their annual Flea Market 1000Z-1400Z at Westminster Armouries, 6th St. at Queens, New Westminster BC. Setup at 0900 hrs. Talk-in on VE7RBY 145.35, or 442.85. For more info contact the Club Net *Monday nights at 2000 local time on 145.35*, or write the Club at *Box 72012, 4429 Kingsway, Burnaby BC V5H 4P9, Canada*.

FEB 25

BISMARCK, ND The Central Dakota ARC will hold its annual Hamfest at the Radisson Inn, 800 South Third St., 8 AM-4 PM. Talk-in on 146.85/.25. VE Exams. Ham/Computer Swapmeet. Contact *Tim N0SDB, (701) 663-6620*; or *Mark N0FAZ, (701) 255-7658*.

LAPORTE, IN The Laporte Civic Auditorium is the place to go to enjoy the Laporte Cabin Fever Hamfest. This event will be sponsored by the Laporte ARC, 8 AM-2 PM (Chicago time). Computer enthusiasts welcome. Talk-in on 146.610 (-131.8 PL), or 146.520 simplex. Contact *TX John @ (219) 362-1121*, or SASE to *P.O. Box 30, Laporte IN 46351*.

MILTON, VT The Radio Amateurs of Northern Vermont will sponsor the Northern Vermont Winter Hamfest at Milton H.S. on Route 7. Time: 8 AM-3 PM. Flea Market. Auction. Book Sale, more. VE Exams at 9 AM and 2 PM; Commercial exams at 2 PM. Tables free while they last. Call for large setups. Talk-in on 145.15 Rptr. Contact *WB2J8J at (802) 879-6589*.

FEB 25-26

CINCINNATI, OH The 1995 ARRL Great Lakes Div. Convention will be held at the Cincinnati Gardens Exhibition Center, 2250 Seymour Ave. Exhibits open at 8:30 AM Sat. and Sun. For details, call *Stan Cohen WD8QDQ, (513) 531-1011*.

FEB 26

LIVONIA, MI Livonia ARC will present its 25th "Silver Anniversary" Swap'n Shop 8 AM-3 PM at the Dearborn Civic Center in Dearborn. VE Exams. Talk-in on 144.75/5.35. For info, send a 4" x 9" SASE, *c/o Neil Coffin WA8GWL, Livonia ARC, P.O. Box 2111, Livonia MI 48151*, or phone *(313) 261-5486*.

NEW BERLIN, WI A Swapfest and Computer Fair sponsored by SEWFARS, 146.820 Reptr. Soc., MACE, and The Milwaukee Computer Club, will be held at Kuglitsch's Entertainment Center at 16000 W. Cleveland Ave. VE Exams. Reservation deadline is Feb. 11th. Make checks payable to SEWFARS/MACE Swapfest, and mail with SASE to *P.O. Box 102, Delafield WI 53018. Tel. (414) 771-1250; FAX (414) 542-7474*. Talk-in on 146.820 Rptr. LLBBS (414) 789-1034.

VIENNA, VA The 19th ARRL sanctioned Vienna Wireless Soc. Winterfest will be held at the Vienna Comm. Center. VE Exams will be held on Feb. 25th. Talk-in on 146.91 and 146.685. For info please call *Christine KE4HWE, (703) 560-7399*, or *Jorge KE4DGQ, (703) 729-4711*.

MAR 4

ABSECON, NJ The Shore Points ARC will sponsor its 13th annual hamfest, "Springfest '95" at Holy Spirit HS, on Route 9 (3/4 mi. south of Route 30. Doors open at 9 AM. Setup at 7 AM. VE Exams registration at 9:30 AM; testing at 10 AM. Flea Market. Talk-in on 146.385/.985. For info write to *SPARC, P.O. Box 142, Absecon NJ 08201*.

MAR 5

NORTHAMPTON, MA The 11th annual MTARA Amateur Radio Flea Market will be held at Smith Vocational School, RTE 9. Setup 8 AM. General admission 9 AM. VE Exams 10 AM; contact *Jim WA1ZUH, (413) 245-3228*, or *@ MTMBBS* via packet. Advance registration strongly recommended. The vendor contact is *Jim K1MEA, (413) 527-3199, eves. before 2200 EST*.

MAR 12

YORK, PA The 8th annual York Springfest (Ham & Computer) will be held at the York Fairgrounds starting at 8 AM. W5YI VE Exams at 8 AM. Talk-in on 146.97(-). For info and advance registration, call *(717) 843-7864*, leave message or FAX, or write to *York Springfest, P.O. Box 526, Red Lion PA 17356*.

MAR 18-19

FORT WALTON BEACH, FL The Playground ARC will hold their 25th annual North Florida Ham/Swapfest at the Ft. Walton Beach Fair Grounds, 8 AM-5 PM on the 18th; 8 AM-3 PM on the 19th. Giant indoor Flea Market. For tables, call *Bud K8YNU, (904) 243-5404, 9 AM-5 PM CDT*; or *Scott KE4BFT, (904) 244-3182, 5 PM-9 PM CDT*. For RV space only, call *Roberta, (904) 862-0211*. Address all inquiries to *P.A.R.C., P.O. Box 873, Ft. Walton Bch. FL 32549*.

APR 28-30

DAYTON, OH The Dayton ARA Inc. will hold their annual HAMVENTION at Hara Arena. Giant 3 day Flea Market. Exhibits. Activities for the Non-Ham. *FAX: (513) 274-8369; FAXMail (513) 276-6934. BBS via America Online: (513) 276-6930;* Keyword "Ham", select "Hamvention"; License exams by appointment only; call FAXMail or BBS for details. Mailing address *Hamvention, Box 964, Dayton OH 45401-0964*. Advance registration deadline is Apr. 1st for Canada, Apr. 8th for the USA. Flea Market tickets by advance registration only. Free bus service will be provided between Hamvention, Air Force Museum, Salem Mall and Forest Pk. Mall parking areas. Please call BBS or FAXMail for info.

SPECIAL EVENT STATIONS

JAN 28

YANKEE SPRINGS, MI The Barry County A.R.E.S. Team, a div. of the Barry Comm. Network (BACON), will operate KG8KL 1300Z-1800Z in conjunction with the 14th Gun Lake WinterFest. Operation will be in the General portions of the 80, 40 and 20m bands, and if conditions permit, 15m. Novice CW portion of the 80 and 40m bands; and Novice voice portion of the 10m band, if conditions permit. For a QSL certificate, send a #10 envelope and return postage to either *N8ZSG, 89 Woodstrail, Delton MI 49046*; or *KG8KL, 118 S. Hanover, Hastings MI 49058*.

FEB 3-5

SAN PEDRO, CA The United Radio Amateur Club will commemorate the 50th Anniversary of the ST695 Angels Gate tug boat by operating Station K6AA 10 AM-8 PM Fri., 7 AM-8 PM Sat., and 8 AM-5 PM Sun., local time. Operation is planned for 10m SSB, 15m CW and SSB, 20m CW and SSB, and 40m CW and SSB. Write *URAC, Los Angeles Maritime Museum, Berth 84, Foot of Sixth St., San Pedro CA 90731*.

FEB 11-12

WEST PALM BEACH, FL A Fox Hunt will be sponsored by the West Palm Bch. ARC, 1400 UTC-2000 UTC Feb. 11th and 1700 UTC-1900 UTC Feb. 12th. This event is open to all interested parties, licensed and unlicensed. To register, send $1.00 donation and registration request to *Fox Hunt, c/o Dick Schofield KE4CGQ; Sam Falco KD4VGI; or Dennis Hamilton AD4PS, P.O. Box 6834, West Palm Bch. FL 33405-6834*. Feb. 10th is the registration deadline. Obtain official WPBARC Fox Hunt Logs from KE4CGQ, KD4VBI, or AD4PS at the address above.

FEB 18-19

MT. VERNON, VA The Mt. Vernon ARC will operate Station N4BV from 1600Z-2000Z both days, to commemorate George Washington's birthday. The station will be located on Washington's Mt. Vernon Estate. Frequencies: Lower General 80m-15m phone and CW subbands, Novice 10m phone subband, and 2m packet @ WA3TAI.MD.USA.NOAM. For a certificate, send QSL and a 9"x 12" SASE to *Steve Schneider WB4EEA, 8602 Cushman Place, Alexandria VA 22308*.

FEB 25-26

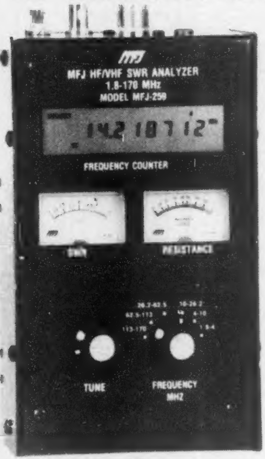
GLENVIEW, IL The Lake County (IL) RACES/ARES Group will operate N9US from 1500Z Feb. 25th-2100Z Feb. 26th, observing the end of flight operations at Glenview Naval Air Station (after 58 years of naval air service). CW - 3.580, 7.035, 14.030, 21.140; Phone - 3.880, 7.280, 14.280, 21.320, 28.430; OSCAR 10/13 satellite 145.910; Packet 145.03. For a certificate, send QSL and a 9" x 12" SASE to *Lake County RACES/ARES, 1303 North Milwaukee Ave., Libertyville IL 60048*.

GRANDE PRAIRIE, ALBERTA, CANADA Members of the Peace Country ARC will operate CQ6ARC from the site of the 1995 Canada Winter Games. Operation will be from 1700Z-2300Z each day, around 14.240 MHZ(+/-); also, Satellite AO-27 and FO-20, as conditions permit. For a certificate, send QSL and a 9" x 12" SASE to *CG6ARC, P.O. Box 767, Grande Prairie, Alberta, Canada T8V 3R5*.

VIRGINIA BEACH, VA The Virginia Beach ARC will operate WA4TGF 1400Z Mar. 25th-2000Z Mar. 26th, to commemorate the 104th Anniversary of the NORWEGIAN LADY. CW—10 kHz up from the bottom of the Novice subbands; Phone - 3.880, 7.280, 14.280, 21.280, 28.363, and 146.550. For a certificate, send QSL and SASE to *VBARC, P.O. Box 62003, Virginia Beach VA 23462.*

MFJ *HF/VHF* SWR Analyzer™ with RF Resistance Meter

Read your antenna SWR from 1.8-170 MHz . . . 10-digit LCD frequency counter . . . RF Resistance Meter™ . . . smooth reduction-drive tuning . . . simple-to-use . . .



MFJ-259
$219.95

If you work with antennas, MFJ's revolutionary new *SWR Analyzer™* is the best investment you'll ever make! Now you can diagnose a wide range of antenna problems instantly with one easy-to-use instrument.

What the MFJ-259 Does

The MFJ-259 gives you a complete picture of your antenna's performance anywhere between 1.8 and 170 MHz -- you can even check SWR outside the ham bands without violating FCC rules. Set the bandswitch and tune the dial--just like your transceiver. SWR is displayed instantly!

RF Resistance Meter™

Does 2:1 SWR mean 25 ohms or 100 ohms? *The new MFJ-259 tells you at a glance!*

Now you can measure RF resistance up to 500 ohms at minimum SWR -- instantly -- on MFJ's *exclusive* side-by-side RF Resistance and SWR Meters!

Take the guesswork out of building matching networks and baluns for your antennas.

Watch the effects of spacing on radiation resistance as you adjust your antenna.

Here's What You Can Do . . .

Find your antenna's true resonant frequency from the shack.

Tune the antennas on your tower and watch SWR change instantly as you make each adjustment. You'll know exactly what to do by simply watching the display.

Tune critical HF mobile antennas in seconds -- without subjecting your transceiver to high SWR.

Measure your antenna's 2:1 SWR bandwidth on a single band, or analyze multiband performance over the entire spectrum from 1.8 to 170 MHz!

Measure inductance, capacitance, resonant frequency of tuned circuits, transmission line velocity factor/impedance/loss. Test RF chokes, transformers, baluns.

Adjust your tuner for a perfect 1:1 match without creating QRM.

And this is only the beginning! The MFJ-259 is really *four* test instruments in one: an accurate RF signal generator, a high resolution 170 MHz frequency counter, *RF Resistance Meter™* and an *SWR Analyzer™*.

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MFJ comprehensive 18 page instruction manual is packed with useful applications -- all explained in simple language you can understand!

For free manual write or call MFJ.

Take It Anywhere

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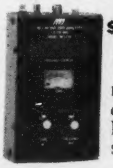
1.8-170 MHz *SWR Analyzers™*



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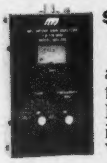
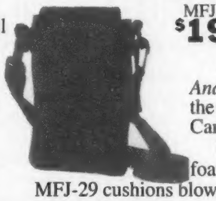
MFJ-249 *HF/VHF SWR Analyzer™* has all the features of MFJ-259 but less RF resistance meter. Includes 1.8-170 MHz *continuous* coverage, 10-digit LCD frequency counter and smooth vernier tuning.



MFJ-209
$109.95

MFJ-209 *HF/VHF SWR Analyzer™* is same as MFJ-259 without LCD frequency counter and RF resistance meter. Has jack for external frequency counter. MFJ-249/MFJ-209 are 4x2½x6¾ inches and uses 8 AA cells or 110 VAC with MFJ-1312B, $12.95.

Carrying Pouch



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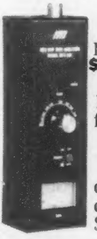
$79.95

If you're an HF man, this compact MFJ-207 *HF SWR Analyzer™* will help you build 10-160 Meters antennas that'll make working DX almost routine.

Just plug in your coax to find the SWR of any HF antenna on any ham band 10-160 Meters. Has jack for external frequency counter. 7½x2½x2¼ inches.

2 Meter *SWR Analyzer™*



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MFJ-208 2 Meter *VHF SWR Analyzer™* finds the SWR of any antenna from 138-156 MHz. Jack for external frequency counter. 7½x2½x2¼ inches.

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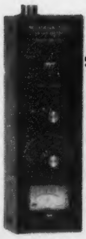
MFJ-219/218/217/208/207/203 uses 9 volt battery or 110 VAC with MFJ-1312B, $12.95.

Bandswitch Dip Meter™



MFJ-203
$99.95

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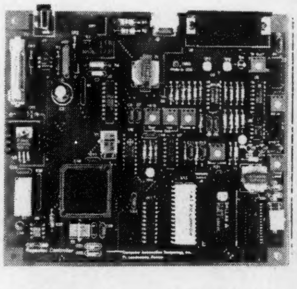

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PROPAGATION

Jim Gray W1XU

Jim Gray W1XU
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Payson AZ 85541

The outlook for February seems generally favorable in spite of declining sunspot numbers, with a few days which are expected to be Poor or Very Poor (see the chart) due to ionosphere disturbances. The remaining days ought to provide reasonable opportunities when Good, Fair, or trending conditions may be expected. You can improve your DX chances by listening to WWV at 18 minutes after any hour for updates on propagation conditions and coordinating their reports with the accompanying charts to pick and choose the most likely days, times and bands to operate.

As I write this on November 30th, I am pleased to note that about mid-morning local time there were some short-skip signals on 17 meters with strengths of S8 to S9. Today was predicted to be GOOD on the November chart. Although I don't listen regularly to 17 meters, my QSO with a Minnesota station proved the need to listen regularly—even on bands that might not be considered favorable, or on days and at times when DX is not expected, and send out a CQ into an apparently very quiet band with few or no signals.

10 and 12 Meters

Only occasional F2 openings to the tropics on GOOD days during daylight hours. Not much sporadic E or short skip propagation can be expected. Skip is where you find it, so keep looking and hoping. Sometimes results are spectacular on a supposedly "dead" band. Really good "gain" antennas can help a lot this month. A good local band.

15 and 17 Meters

Fairly good DX into the Southern Hemisphere during daylight hours from noon to sunset *local* time, and short skip from sunrise to sunset, but expect the band to close soon after—abruptly!

20 Meters

Daylight hours should be pretty good for DX this month in spite of depressed conditions in general, and you may even find the band open until midnight. Peaks ought to occur just after sunrise and late afternoon *locally*. If the band does stay open after dark, look for openings into South America and even Antarctica. Also, during the day, you will find considerable short skip. All of which means that 20 meters should be your PRIME DX BAND. (See 80 meters, too.)

30 and 40 Meters

Expect late afternoon and evening openings into Europe and Africa swinging south after sundown for a few hours, but the MUF falls below 7 MHz later in the evening. Short skip will occur during most days out to 1,000 miles or so, and to 2,000 miles at night until the band closes.

For you newer operators who have not lived through a complete sunspot cycle, there will be some great surprises in store. Listen and learn.

80 Meters

This will also be a very good DX band after dark, and since QRN is low, signals ought to be very readable . . . even weaker ones. Peak DX occurs around midnight local time and just before sunrise. Insomniacs will *love* 80 meters this month. Short skip at night will occur frequently out to 2,000 miles. Isn't it interesting how two of our "oldest" bands, 80 and 20, are the best in these times? The old-timers knew what they were doing when they "got" these bands for amateurs way back when.

160 Meters

You "top band" operators will love this band in December: DX openings to the east from your locations, peaking around midnight (Europe, etc.), and toward the south and west before sunrise. Nighttime short skip should also be good from dusk to dawn, getting longer later. On this band, use vertical antennas to transmit and horizontal antennas for receiving, preferably Beverage antennas if you have the room. Low noise and minor static will make you happy. 73

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
AGENTINA	20	40	40	40	80	80				20	15	15
AUSTRALIA	20		20		40	40	20	20			15[1]	15[1]
CANAL ZONE	15	20	20	40	40		20	20	15	15	15*	15*
ENGLAND	20	40	80	40	40		20	20	20	20	20	20
HAWAII	20		20		40	40	80	20			15[1]	15[1]
INDIA	20/40*					20[1]	40[1]	20[1]				15[1]
JAPAN	20						20	20				20
MEXICO	15	20	20	40	40		20	20	15	15	15*	15*
PHILIPPINES							20					
PUERTO RICO	15	20	20	40	40		20	20	15	15	15*	15*
SOUTH AFRICA			40[1]	40[1]				15	15	15	20	20
U.S.S.R.	40	80	80	40			20	20	20			40
WESTCOAST		80	80	40	40	40	20	20	20			

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA						80*	40*	20				
ARGENTINA	20		40	40	40						15	15
AUSTRALIA	15					40	20	20	20			15
CANAL ZONE	20	80	40	40	40	40	20	20	15	15	15	20
ENGLAND	40	40	40	80				20	15	20		40
HAWAII	15	20			40	40	40				15	15
INDIA	15[1]	20[1]	20[1]				40[1]	20[1]	20[1]			
JAPAN						80*	40*	20				
MEXICO	20	80	40	40	40	40	20	20	15	15	15	20
PHILIPPINES								20				
PUERTO RICO	20	80	40	40	40	40	20	20	15	15	15	20
SOUTH AFRICA	20	40*							15	15	20	20
U.S.S.R.	40		40	40				20	20			

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	15	20			40	40	40	40	40			20
ARGENTINA	15	20		40	40	40	40	40		15	15	15
AUSTRALIA	15	20	20				40	80*	40	15	15	15
CANAL ZONE	20	20		40	40	40			20	15	15	15
ENGLAND			80*	40					20	20		
HAWAII	15	15			20	20	20	20				15
INDIA		20										
JAPAN	15	20			40	40	40	40	40			20
MEXICO	20	20		40	40	40			20	15	15	15
PHILIPPINES	15	20					40	40		20		20
PUERTO RICO	20	20		40	40	40			20	15	15	15
SOUTH AFRICA	20	40[1]	40[1]							15	15	20
U.S.S.R.		40[1]	40[1]	40[1]	40[1]				20	20		
EAST COAST		80	80	40	40	40	20	20	20			

1=May be open only once or twice during month. *=Try next higher band

FEBRUARY 1995

SUN	MON	TUE	WED	THU	FRI	SAT
			1 F	2 F-G	3 G	4 G-F
5 F	6 F	7 F	8 F-G	9 G-F	10 F-P	11 P-VP
12 VP-P	13 P	14 P-F	15 F	16 F-G	17 G	18 G
19 G-F	20 F	21 F	22 F	23 F-G	24 G	25 G
26 G	27 G	28 G-F				

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So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham newcomer or retired old-timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

Send your ads and payment to the Barter 'n' Buy, *73 Magazine*, 70 Rt. 202N, Peterborough NH 03458, and get set for the phone calls.

The deadline for the April 1995 classified ad section is February 9, 1995.

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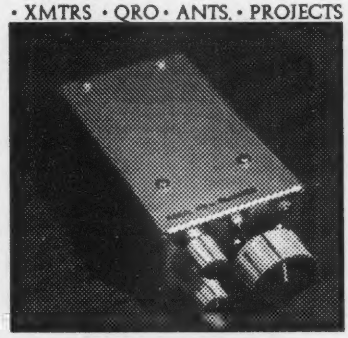

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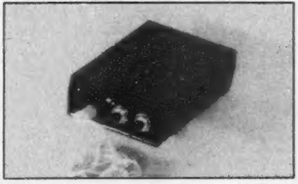

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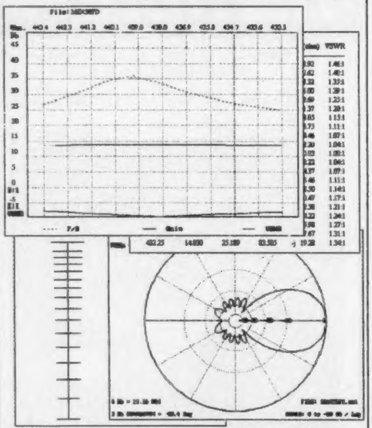

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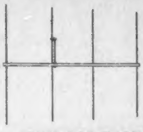

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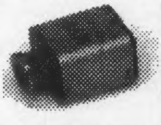

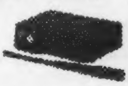

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02D42 **Digital Novice** *by Jim Grubbs* Geared to make you a more knowledgeable participant. **$8.50**

W5GWNC **Technician Class License Manual: New No-Code** *by Gordon West* This book covers everything you need to become a Technician Class Ham. Every question and answer on the examinations is found in this one book. FCC Form 610 application. **$9.95**

01A87 **Shortwave Listener's Antenna Handbook** Primer antenna theory. **$13.95**

AR4432 **W1FB's Help for New Hams** *by Doug DeMaw W1FB* Complete for the newcomer. Put together a station and get on the air. **$10.00**

AR2286 **First Steps in Radio** *by Doug DeMaw W1FB* Series of *QST* articles. **$6.00**

CODE TAPES

73T05 **"Genesis" $5.95**
5 wpm—This beginning tape, takes you through the 26 letters, 10 numbers, and necessary punctuation, complete with practice every step of the way.

73T06 **"The Stickler" $5.95**
6+ wpm—This is the practice tape for those who survived the 5 wpm tape, and it's also the tape for the Novice and Technician licenses. It is comprised of one solid hour of code. Characters are set at 13 wpm and spaced at 5 wpm.

73T13 **"Back Breaker" $5.95**
13+ wpm—Code groups again, at a brisk 13+ wpm so you'll be really at ease when you sit down in front of a steely-eyed volunteer examiner who starts sending you plain language code at only 13 per.

73T20 **"Courageous" $5.95**
20+ wpm Congratulations! Okay, the challenge of code is what's gotten you this far, so don't quit now. Go for the extra class license. We send the code faster than 20 per.

73T25 **"The Mind Boggler" $5.95**
25+ wpm Fiendishly generated by kindly old Uncle Wayne for hams with a strong need for self punishment. Once you've conquered 25 per let Unk know if you need a 50 wpm tape.

WAYNE WRITES

WG1 **We The People *Declare War* On Our Lousy Government**—360p soft cover. This is Wayne's report to the New Hampshire Economic Development Commission explaining what the major problems are facing both New Hampshire and the country, and proposing simple, inexpensive solutions. Wayne proposes a simple way to have government departments happily cut their expenses by 50% within three years; how to cut the cost of incarcerating prisoners by over 90%; how to end welfare; how to reduce the deficit; how to cut medical costs and improve health care; how to cut school costs and improve schools. An absolute steal at $13.

WG4 **20/20 Foresight**—Twenty 16p updates on the **Declare War** book—320p. Further proposals for solving critical American problems, such as a new approach to financing small businesses, how to finance Russia and other countries and make a profit doing it, the real dope on bioelectromagnetics, a new kind of polytechnical university, a new electronics technology, why Africa is in such a mess, why Perot bombed, how to have tuition-free universities, a plan for making Congress turn honest, etc. Plenty more. One of the best $10 you'll ever spend. Ridiculously priced at $10.

WG5 **Submarine Life in WWII**—60p. Wayne's story of his adventures on the USS Drum SS-228 on five war patrols in the Pacific in 1943-45. What's it really like on a submarine when you're being depth charged? And what's the day-to-day life on a submarine like? Did you see the movie Das Boot? This is a collection of stories originally published in the *Drum Newsletter*. Exciting stuff and only $7.50.

WG6 **Uncle Wayne's Caribbean Adventures**—96p. Wayne's adventures scuba diving all around the Caribbean, visiting ham operators, and sightseeing. If you're interested in how to travel economically, you'll get some great ideas from this. Wayne and his wife Sherry sure know how to travel economically. He starts out with his "Diving, the Wimp Sport." You'll love their visit to 11 islands in 21 days trip. A measily $7.50.

WG7 **Uncle Wayne's Travels**—52p. Wayne travels to Russia, London, Aspen, St. Pierre, Munich, Vienna, Krakow, and Prague without it costing nearly as much as you might think. Cheap for you too, at $5.00.

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NEW PRODUCTS

Compiled by Charles Warrington WA1RZW

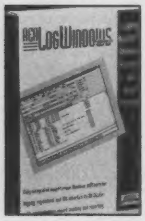
SOFTWARE SYSTEMS CONSULTING

SSC has begun shipping version 4.0 of the PC GOES/WEFAX software/hardware system. PC GOES/WEFAX 4.0 is for the IBM PC and compatible computers and allows users to receive and process weather satellite pictures directly from weather satellites on VHF, microwave, or from shortwave frequencies.

The package includes a radio facsimilie modem that connects to the PC serial port and to the radio receiving equipment, image processing software, a comprehensive 300-page manual, broadcast schedules, an orbital prediction system, and a tutorial audio cassette.

Suggested retail price for the package is $250. For more information or to order visit your favorite dealer or contact *Software Systems Consulting, 615 S. El Camino Real, San Clemente, CA 92672; (714) 498-5784.* Or circle Reader service No. 202.

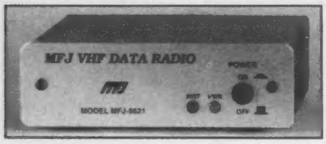
ADVANCED ELECTRONIC APPLICATIONS



AEA has announced delivery of Log Windows 2.0. Logging, rig control, and DX cluster monitoring with award tracking and reporting—it's all part of AEA's newest Log Windows 2.0.

This new version is compatible with PC PackRatt for Windows version 2.0 as well. Antennas can be tuned to the short path, long path, or any other direction with the simple click of a mouse. A new database browser allows you to sort and print logs by any criteria. Users can also enjoy on-line *Callbook* databases at any time.

There are additional features to this product far too numerous to mention. The suggested retail price for Log Windows 2.0 is $99. Upgrades are available. For more information or to order, visit your favorite dealer or contact *Advanced Electronic Applications, Inc., P.O. Box C2160, Lynnwood, WA 98036; (206) 774-5554, FAX (206) 775-2340.* Or circle Reader Service No. 203.



MFJ

The new MFJ-8621 Data Radio will monitor "packet only" on your favorite packet channel for continuous 24-hour-per day duty. It won't stop monitoring packet unless you want it to.

This new radio is a 2 meter FM data receiver that will run all data rates through 9600 straight out of the box.

Simply attach a TNC cable, antenna, and 12VDC supply and you're receiving high-performance error-free packet. The unit is priced at $119.95. For more information or to order contact *MFJ Enterprises, Inc., P.O. Box 494, Mississippi State, MS 39762, (601) 323-5869, FAX (601) 323-6551.* Or circle Reader Service No. 206.

TOOL PAK

Tool Pak has introduced the new Tool Vest for the serious radio amateur. The Tool Vest is designed for the worker who wants all his tools conveniently available without compromising safety. The Tool Vest easily fits over clothing, adjusting to a wide range of sizes with four expandable side release buckles. It is particularly well-suited for working in high places.

20 front pockets organize those tools you always need. One large rear pocket is accessable from both sides. Bright panels front and rear aid visibility.

The Tool Vest is priced at $54.97. For more information visit your favorite dealer or contact *Tool Pak, 7307 82nd St. Ct., SW Tacoma, WA 98498, (206) 584-4914, FAX 589-1091, (800) 258-8458.* Or circle Reader Service No. 207.

PCS-9600D
438.940
AZDEN

AZDEN

Enjoy true 9600 baud packet radio on 440 MHz with Azden Corporation's newest 35 watt digital packet radio, the PCS-9600D.

The PCS-9600D transceiver incorporates all the special features required by high speed packet radios. The rig features 35 watt high power output, 20 kHz wideband IF, wide frequency range from 430-450 MHz and solid state diode TX/RX switching. A full TouchTone microphone is included for voice operation when needed.

The unit is priced at $649. For more information or to order visit your favorite dealer or contact *Azden Corporation, 147 New Hyde Park Road, Franklin Square, NY 11010; (516) 328-7500, FAX (516) 328-7506.* Or circle Reader Service No. 208.

SESCOM

SESCOM, Inc. has released its new 1995 Constructor's Catalog. This updated and expanded booklet features new and innovative electronics packaging solutions along with hard-to-find items. It also serves to introduce SESCOM's two newest product lines.

The RACKEM 'N' STAKEM Series is a comprehensive line of half-rack-sized boxes, racks and mounting accessories.

The BOX-IT System is designed to make constructing easy and fast. BOX-IT boxes are available in many sizes and panels are cut to assorted sizes and simply slide into the boxes' rail system. These common hole sizes and patterns are prepunched to eliminate work for the builder. A variety of components are also available for small-quantity purchases.

For more information or to receive a catalog contact *SESCOM, Inc. 2100 Ward Ave., Henderson, NV 89015-4249; (702) 565-3400, FAX (702) 565-4828.* Or circle Reader Service No. 204.

Constructor's Hardware for the 90's
SES COM
SESCOM, INC.

PENTODE
HAM University

AMATEUR RADIO EDUCATION

Amateur Radio Education, a new company specializing in software products, announces "Ham University," a new Windows program for learning amateur radio theory and Morse code for all license levels. An interactive game called Pentode makes learning the code and speedbuilding fun.

The program uses Hyper-Text help files to assist the student in better understanding the theory behind each question and answer. System requirements are a 386 computer or better, Windows 3.1, DOS 5.0 and a sound card for the Pentode Morse code game.

For more information contact *Amateur Radio Education, Inc., 19302 Pauline Lane, Huntington Beach, CA 92646; (714) 968-0042, FAX (714) 965-1016, Internet BGREGG@CALSOFT.COM.* Or circle Reader Service No. 205.

TOWER JACK

Hams know that taking down tower sections can be a backbreaking chore. You don't have to go it alone anymore with the introduction of the new Tower Jack product.

This sturdy device will help you dismantle tower sections whether you're up 15 feet or 150 feet. Pictured here is Tower Jack's inventor Jeanene N5UHL with OM Kenny WB5JLZ demonstrating her new patented tool.

The Tower Jack is priced at $49 retail, $36 ham net. For more information or to order contact *Tower Jack, P.O. Box 82321, Baton Rouge, LA 70884-2321; (504) 924-7708.* Or circle Reader Service No. 201.

NEW HF

Compact HF Transceiver FT-900AT

Introducing an HF that's going places.

"With the small snap-off remote front panel design, it's an HF mobile."

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for details call or write
Yaesu USA Today!
★1995★

"It's a great base, too. Direct keypad entry, built-in antenna tuner, CW keyer with adjustable speed, 100 Watts, Omni-Glow display... Wow!"

"Yaesu did it again!"

Uncompromising HF quality that will change your lifestyle. It's the first transceiver with true HF technology to go mobile in any vehicle or stay at home as a compact base station.

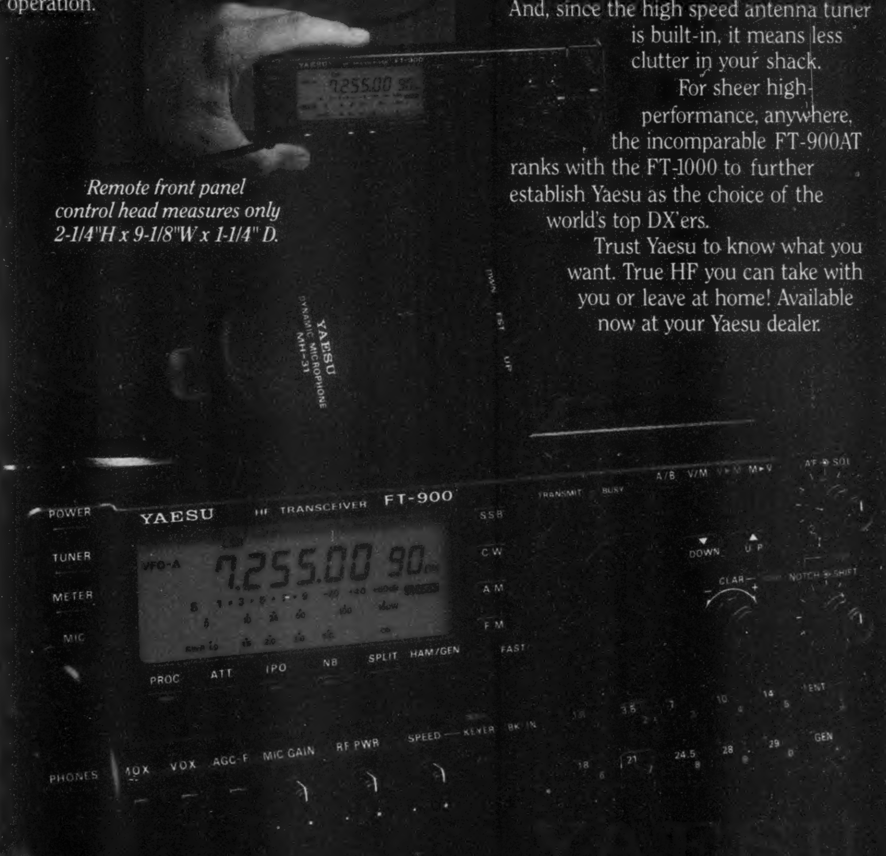
With its revolutionary, small, snap-off remote panel, the controls of the FT-900AT can install almost anyplace in your car, truck or camper. Since the 100 Watt RF deck can be installed under a seat or in your car trunk, it's away from critical automotive electronic wizardry. And, for ultimate convenience, the built-in antenna tuner simplifies in-car operation.

As a base station, the compact full function FT-900AT includes direct keypad entry for pinpoint accuracy during quick band/frequency changes. Other features you'll like include CW keyer with front panel speed adjustment, speech processor, twin stacking VFOs, and IF Shift and Notch. No competitor offers this! Bonuses, such as signal strength, power output, SWR and ALC digital meters, add value to the FT-900AT, and the proven duct-flow cooling system provides excellent long-term transmit power output reliability and frequency stability. For ease of use, Yaesu's exclusive Omni-Glow display enhances viewing in any light condition. And, since the high speed antenna tuner is built-in, it means less clutter in your shack.

The FT-900AT controls mount almost anywhere in your car, truck or camper. 100 Watt RF-deck can mount in trunk, or under seat.

For sheer high-performance, anywhere, the incomparable FT-900AT ranks with the FT-1000 to further establish Yaesu as the choice of the world's top DX'ers.

Trust Yaesu to know what you want. True HF you can take with you or leave at home! Available now at your Yaesu dealer.



Remote front panel control head measures only 2-1/4"H x 9-1/8"W x 1-1/4" D.

Specifications

- Remote Front Panel Design
- Built-In Auto Antenna Tuner
- Direct Keypad Entry when used as a Base Station
- Large, Bright Omni-Glow™ LCD Display
- 100W on SSB, CW, FM modes; 25W on AM
- IF Shift and 30db Notch Filter
- Digital S/RF, SWR & ALC Meters
- Programmable CTCSS Encode w/Repeater Offset
- Direct Digital Synthesis (DDS)
- 100 Memory Channels
- Frequency Range
  - RX: 100 kHz-30 MHz
  - TX: 160-10 meters
- CW Full Break-in Keying w/ Adjustable Speed
- Fast/Slow AGC Circuit
- Intercept Point Optimization
- Duct Flow Cooling System
- Twin Band Stacking VFOs
- Built-in Noise Blanker
- Built-in Adjustable Speech Processor

ACCESSORIES:

YSK-900 Remote Mount Kit
MMB-62 Controller Bracket
MMB-20 Mobile Mtg. Bracket
SP-7 Mobile External Spkr.
SP-6 Base Station External Spkr.
DVS-2 Digital Voice Recorder
FP-800 20A HD Power Supply
YH-77ST Headphone

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Choice of the World's top DX'ers

Specifications subject to change without notice. Specifications guaranteed only within amateur bands. Some accessories and/or options are standard in certain areas. Check with your local Yaesu dealer for specific details.

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TONE
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TM–241A

FM MOBILE TRANSCEIVER

Pure and simple, the concept reads like this: "rock-solid performance with straightforward operation, at an affordable cost". And Kenwood's TM-241A (144MHz) FM mobile transceiver symbolizes this perfectly.

Great looks and rugged construction are just the beginning. The TM-241A's user-friendly controls make mobile QSOs a snap, and a powerful 50-watt amplifier lets you work simplex with confidence or hit those distant repeaters. Reception specs are equally impressive; intermod characteristics have been improved* to reduce interference from strong adjacent band signals. Plus, there are 20 multi-function memory channels for programming combinations of frequency, sub-audible tone, and repeater offset.

So, if you're looking for true mobile performance, go back to the basics and reach for Kenwood's TM-241A.

Features

- 144-148 MHz TX, 118-174 MHz RX
- 50 watts RF output
- 20 multi-function memory channels
- Large LCD display with illuminated keys
- Full band scan, programmable band scan, memory scan with channel lock-out
- Time-operated & carrier-operated scan modes
- Built-in selectable CTCSS tone encoder
- Auto repeater offset
- Tone alert with elapsed time indicator
- DTSS for selective calling and paging (with optional DTU-2)
- Time-out timer
- Auto power-off with warning beeper
- Meets U.S. military standards for shock and vibration (MIL-STD 810C/D/E)*
- Modifiable for MARS/CAP use (permits required)

These specifications guaranteed for Amateur band only.
*Current K&K2 versions with serial number 5080000 or later.

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